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ENGINEERING AND MINING JOURNAL

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

Prolonging the Life of the Smuggler Union Enterprise

In 1923 circumstances conspired to threaten the immediate shutting down of the Smuggler Union mine in the San Juan region in Colorado. The story of how the ills of the enterprise were diagnosed and radical steps taken to extend its active career is related by the mining engineer who was selected as president and general manager at the critical time.

By Robert Livermore

The Weakest Link; or, Saving Time in Mine Examinations

Too frequently the size and physical appearance of a mine report and the harmonious color scheme of the maps that accompany it are the criteria by which its value is judged. A well-known engineer-geologist points out that the essence of any mine report is the final recommendation. He offers other novel and pertinent ideas on the subject.

By Ira B. Joralemon

New Cyanide Plant at Midas, Nevada

A description of the flow sheet and operating details

By Milo Carlston

Biographical Sketch of H. G. Moulton

Useful Operating Ideas . . . Company Reports . . . Current Prices of Supplies

"It's Good Mining"

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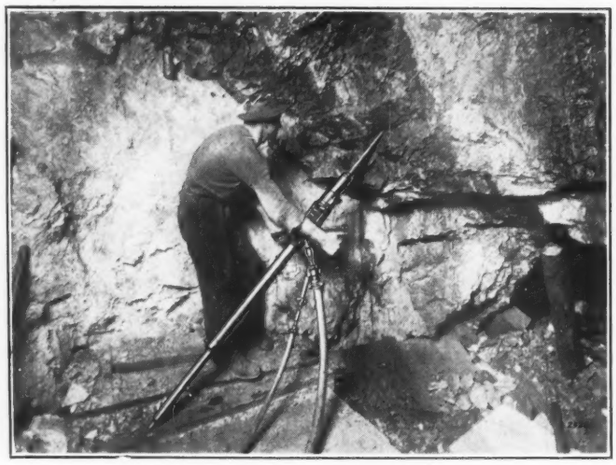

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Is Unemployment the Price of Industrial Progress?

IT HAS BEEN CLAIMED that the substitution of mechanical power for manual labor is the cause of unemployment. To some extent it must be; a revolutionary change in production methods cannot fail to affect the labor market; but compensating factors are noticeable. Mr. Magnus W. Alexander, president of the National Industrial Conference Board, discussed the problem recently before the Fortnightly Forum. In the course of his speech he showed that in 1925, as compared with 1914, 71 wage earners instead of 100, and 82 managerial and supervisory officials instead of 100, produced the same volume of goods. The cost of management in 1925 was 10 per cent less, and the cost of labor, in spite of wage levels about twice as high as those prevailing before the war, was reduced about 4 per cent per unit of production, as compared with the cost in 1914. Yet hours per worker were 9 per cent less than in 1914, with a productivity per worker that was 40 per cent greater.

This remarkable showing has been due almost entirely to the increase in the amount of power used, in the improvements made in tools and methods, and by the coordination of basic production factors. The mechanization of industrial America has been a fundamental factor in the accumulation of wealth and the attainment of general prosperity that has attracted worldwide notice.

Interest must go beyond the figures given, however, to determine what happens to the workers displaced by the machine. A vast increase in consumption has occurred. Although output per worker increased 40 per cent between 1914 and 1925, the total production during that period increased more than 65 per cent. In other words, whereas 71 workers in 1925 produced as much as 100 did in 1914, the demand for goods at a lower price and in greater variety, made possible by more efficient methods and the more extensive mechanization of processes, expanded to an extent permitting the re-absorption of the 29 per cent of the workers ousted by the machine, plus an additional one and one-half millions.

Although these figures refer specifically to the manufacturing industries, they will be found to apply in similar measure to the more basic industries, such as metal mining and construction. The improvements made in processing methods, the avoidance of hand labor and the substitution of the machine—all these have reduced the payroll; but the ultimate economies secured have lowered the selling price of the product to a point insuring a considerable increase in the output, so that the employment situation, so far as the wage earner is concerned, has changed but little. High wages prevail in all industries, whereas the cost of living is not higher in the same proportion than it was before the war, the net result being that the worker has a greater purchasing power; and, we might add in parentheses, the number of millionaires is on the increase.

The middleman in the financial structure, including those professional engineers forced to inaction by the consolidation of properties and by the increasing attention paid to large-scale operations, are the real sufferers. It is true here that unemployment is the price paid for technical and engineering progress; but, unlike conditions in the manufacturing industries, there is little hope of re-absorption because of increased output. A mining or metallurgical operation handling 20,000 tons per day needs only a small fraction of the technical help that was required fifteen years ago for the operation of ten properties each mining and milling 2,000 tons per day. The solution of this phase of the unemployment problem is to urge the mining or metallurgical engineer who sees the opportunities for employment being narrowed in the direction of the danger line to break into allied fields of endeavor, where his versatility and skill and experience can be used to his own and his client's advantage and profit.

An Important Domestic Manganese Project Starts

PRODUCTION of domestic manganese ore should show a marked increase in 1928 as compared with that of 1927, when the total was approximately 43,600 tons, according to government statistics. The principal factor in the prospective increase will be the production of the Domestic Manganese & Development Company, organized last year to treat the rhodochrosite ores of Butte by nodulizing. Remodeling of the Butte Reduction Works for this purpose has been accomplished, and on March 15 the new plant was started with fitting ceremony. Its initial capacity is 300 tons daily of finished product, which runs 57 per cent in manganese and in all respects is suitable for making ferromanganese, it is claimed. Officers of the company assert that the nodulized product is superior to the imported ore for furnace purposes. Contracts have been effected with the Anaconda and W. A. Clark interests for delivery of 750,000 tons of "pink" ore within the next five years. The Domestic company, therefore, has its supply of raw material assured. This project was discussed in detail in *Engineering and Mining Journal* of July 30, 1927, by John H. Cole, president of the Domestic company. Besides the ore contracted for, the company expects to draw upon rhodochrosite resources elsewhere in the Northwest. It already has certain deposits under lease.

Encouragement for all who are interested in domestic manganese is to be found in the progress made with this

undertaking. More than this important project, however, will be needed to establish a domestic industry on which dependence may be placed. Domestic interests thus far have successfully combated the idea that the tariff on manganese should be removed or lowered. Apparently the tariff will remain. It is now up to these domestic interests to show what they can do under the protection thus afforded. Of words there have been enough. Action is now in order.

For Betterments and New Undertakings—$9,932,367 in 1927

FROM THE STANDPOINT of the average shareholder the most interesting figure in the report just issued by the American Smelting & Refining Company for 1927 probably is $19.64—the rate of net earnings per share of common stock, after deducting all charges and dividends on preferred shares. Though this compares with $23.38 in 1926, it is second only to that record year in the company's history. Moreover, it was realized during a year when metal-price averages were much lower than in the preceding year. It is to be noted that the company is becoming constantly more important as a miner, as distinguished from a custom smelter; that is, it is producing more metal from ores derived from mines that it owns, controls, or manages and operates under a co-operative agreement. Production of metals from all sources was substantially larger with respect to lead, copper, and zinc; whereas a material decline in gold and silver is shown. One interesting comparison refers to tons of charge smelted. This declined from 5,400,000 to 4,463,000 tons, as the consequence of continued progress in ore dressing, whereby richer concentrates are being produced from ores of the same grade.

One of the most significant figures in the report, however, is the sum of $9,932,367, spent for "new undertakings and betterments." What kind of expenditures are included in this category? A few mining claims, or interests in small properties, in Mexico and elsewhere, were acquired by purchase, but the total amount involved in such transactions is comparatively small. The largest new project is the Buchans River development in Newfoundland, where a large deposit of zinc-lead ore is to be exploited. The Smelting company has acquired what is, in effect, a half interest in the property for a period of fifty years. To the partnership the owners contribute the property; the Smelting company contributes the funds necessary for the building of a branch railway; the development and equipment of the mine; and the erection and equipment of necessary ore-dressing and metallurgical plants. Incidentally, this seems a most equitable basis on which to exploit a new property. Another considerable sum is accounted for by completing the construction of the Shorey copper smelter in Peru, and equipping the Quiruvilca mines, which contribute to the supply of ore for the new smelter. In addition, some other smaller projects come under the head of new undertakings.

At the various mining properties and the different custom smelters and refineries in Mexico and the United States money has been invested in adding new units and in replacing obsolete equipment with more modern installations. This work is entirely distinct from maintenance and upkeep of existing plants; it represents, as the name implies, betterments at the older plants.

But whether for new undertakings or betterments, the expenditure of approximately $10,000,000 has gone for the most part into the purchase and installation of new structural material, new machinery, and new equipment. It reflects, first, the constant need for modernizing mining, milling, and smelting plants, if they are to be expected to yield efficient operating results; second, a progressive policy on the part of the Smelting company in spending money to keep its properties in such condition that they can be operated effectively and economically; and, third, the confidence of the company in the future of the mining industry, not alone in the field of custom smelting but in mine operation as well. No more convincing indication of the fundamental soundness of metal mining as a basic industry could be desired than this expenditure of $10,000,000 for new plant and equipment in a single year by the ably managed A. S. & R. company.

Russo-Asiatic and the Financing of Mount Isa

WHEN the Mount Isa silver-lead field, in Queensland, was discovered in 1923, hope at once inquired if it were another Coeur d'Alene. The same question regarding Keno Hill, in the Yukon, a little earlier, had been answered disappointingly. Reports on the new Australian find since then have been scanned with interest. The evidence gathered to date is that it is "a low-grade proposition and will need to be worked on a very large scale to return a reasonable profit on the large capital necessary for its development," to quote words attributed to Mr. Leslie Urquhart, chairman of Russo-Asiatic Consolidated, which now controls the property. As for reserves, it is estimated that down to the 300 level on the Black Star lode at least 20,000,000 tons of silver-lead ore is available and that the other mines have 400,000 tons of good ore for every hundred feet of depth. Reduction works capable of treating 2,000 tons of ore daily and of producing 56,000 tons of lead bullion per year are to be erected. Ultimately it is planned to erect a plant for making electrolytic zinc.

Difficulties, of course, will be encountered. The road to profitable production is never smooth. Fuel and power for mining and metallurgical operations are not locally available, and the product must be hauled a long distance to the coast and then sent overseas because of the lack of a market in the Commonwealth. Favorable freight rates, however, have been assured on fuel from Bowen and on freight and concentrates between the mines and Townsville, on the seacoast.

The large amount of capital necessary for this project is to be furnished by the Russo-Asiatic interests. Control of the property was secured by them last year through the purchase of 550,000 £1 shares of Mount Isa Mines, Ltd., at par, after the option held by the Anglo-American Corporation had been dropped, possibly with a view to getting better terms.

The spectacle of a new project boldly financed on ambitious lines in a newly discovered area is warming to the cockles of the heart. The more of such enterprise the better, provided it be sound.

China's Minerals

WITH the exception of coal China is deficient in the essential minerals, Mr. R. W. Brock states editorially in the latest issue of *Economic Geology*. His views coincide with those already expressed by Dr. C. K. Leith and Dr. H. Foster Bain with respect to the resources of the East. The Orient, he thinks, will continue to import the essential minerals and their products and to export the minor minerals in their raw state.

A similar conclusion may be reached by a study of facts regarding China's non-ferrous metals, set forth by Mr. Robert Slessor in the Proceedings (dated March 31, 1927) of the Australasian Institute of Mining and Metallurgy. Mr. Slessor in a somewhat lengthy paper does not summarize his findings. His figures and his description of conditions, however, are interesting and speak for themselves.

China has been explored for minerals by Europeans, Mr. Brock reminds us, although this is contrary to a popular view long prevalent. For several decades Western engineers and companies have examined most parts of the country, but with meager results. Moreover, although the major metals and their ores have been known to the Chinese for ages, no abundant resources of such ores have been discovered by them. The minor minerals, such as tungsten, antimony, and sulphur, have been exploited in proportion to their occurrence. It is reasonable, therefore, to infer from the failure to find important deposits of the ores of major metals that they are lacking.

Cleanliness and Order Are Essential to Efficiency

IN THE POPULAR MIND, despite the grandiloquent definitions advanced from time to time, engineers are thought of as those who bend the forces or materials of nature to the service of man. That is their job. The term engineer connotes a degree of order, or at least an absence of disorder and confusion—which amounts to the same thing. Yet at some mines and metallurgical plants refuse is allowed to accumulate, to deface the vicinage. In addition to the waste of space resulting and the demoralization of morale, the disorder is directly or indirectly responsible for accidents, especially falls, both on the surface and in underground workings.

Excuses for such conditions only accuse. Under no combination of circumstances are they necessary or inevitable. Slovenly control is sure to be reflected in careless work. Dirt is matter out of place—except perhaps on the stage. It increases sickness and mortality and labor turnover, and makes the routine of occupational employment and physical existence depressing, unlovely, and hard.

Most of the large operators employ someone whose special function is to try to make the work of mining and milling as agreeable as circumstances permit; but the small property is, all too often, a mess. It need not be. Study of the problem of keeping premises and work places orderly should be a part of the training of every engineer. He should be taught, along with the calculus, to abhor waste, dirt, disorder, and their concomitant inefficiency. Executives, especially, should set an example to their associates and subordinates in this important matter.

Mining need not be benumbing to inherent natural instincts and refinements. It is a noble service and an indispensable one, to society and to humanity. The conditions under which it is conducted should be the best that humanitarian purposes and trained and developed technical management can contrive.

What Constitutes the Mining Industry?

BREADTH OF VISION and an instinct for truth should guide any consideration of the status and the needs of industry. Individual environment, however, operates to foreshorten perspective. Those who have studied the relations and the interrelations of capital and labor, and of management and labor, are familiar with the attitude of mind of both groups, which, all too often, is not one of a realized interdependence, but of suspicion and animosity. When these destructive sentiments are allowed full expression and are translated into action, a deadlock or checkmate ensues, a typical example of which is reflected in conditions in the mining industry in Australia, as detailed by a correspondent in our issue of March 24.

So engrossed have been the respective capital and labor factions in their individual problems that they have, in large measure, overlooked two partners in every industry: the manufacturer, without whose machinery and products the industry could not function or survive; and those who directly supply the customer—the consuming public—the market, which called the industry into being to supply its needs.

A prosperous mining industry creates prosperity also for manufacturers of machinery and of all else used or consumed in production. The manufacturer is a part of the industry—a vital element in it. His research and experimentation have contributed mightily toward the success of most prosperous large-scale mining operations in every corner of the globe. The directing and operating personnel, from president to mucker, should consider the manufacturer as an important and essential factor in the work of producing from mines and quarries the basic necessaries of civilization and culture. Seldom is the fact realized that the maker of tools or machines or supplies contributes with the technician and with men at the drill and shovel to make the industry successful. Moreover, the manufacturer or his representative is the contact man—a veritable liaison officer—carrying a message of progress and technical improvement to all the various elements of an industry.

If your monthly report shows high costs, consult a specialist, and bear in mind that many mechanical devices have been perfected in recent years to reduce operating expense. You will find suggestions in your technical paper, in the descriptive articles, in its advertisement pages, and in those devoted to news of industrial progress. To get full value from your technical journal, know what is in it.

As to the fourth element of an industry, the consuming branch and those who supply it, their needs and preferences determine demand, quality, and price. On their efficient collaboration, on their creative endeavor, all marketing—and all return—are based.

Civilization rests on co-operation. General well-being can be attained only by an understanding of the need for service and the possession of a will to serve.

H. G. MOULTON

H. G. Moulton

Mining Engineer

THOUGH for the last ten years the subject of this sketch has been a successful "sky-scraper" mining engineer in New York, he yields to no one in first-hand acquaintance with hard work in the field. One summer out in Oregon he spent cracking boulders with an 8-lb. sledge so that they would go down a gold-placer flume. He walked four miles to work, put in a ten-hour shift, walked back home, and slept without any misgivings as to whether he had earned his two dollars! Among other jobs that he has held are these: Mine blacksmith, surveyor, smelter chemist, mine bookkeeper, structural-steel worker, railroad-construction foreman, assayer, and sampler. Moreover, he graced most of these positions after he had graduated from the University of Oregon in the course in mining and geology, showing that his "learning" had not unfitted him for earning a living, as it has some other men. H. G. Moulton came honestly by his habit of working and his love for the frontier and for mining. His father and grandfather both were prospectors and pioneers. His father went to California by way of the Isthmus of Panama in 1861. He placered in Orleans Flat on the Yuba River; joined the rush to the Cariboo in British Columbia; prospected and mined in Montana, in the Black Hills of South Dakota, and in the Wood River district in Idaho. His mother went to Utah in a covered wagon. Mr. Moulton was born in Bellevue, Idaho, in 1883. After assisting in a number of mine examinations in Utah, Arizona, and elsewhere from 1907 to 1909, he became associated as examining engineer with Eugene Meyer, a connection that has been maintained ever since. During 1917 and 1918 he was in the mineral division of the War Industries Board in Washington; and later he was consulting mining engineer on subway construction for the New York Public Service Commission. In connection with this work he wrote a paper on "Earth and Rock Pressure" for the A.I.M.E.; and subsequently became chairman of the Institute Committee on Ground Movement and Subsidence. Latterly, his work has been with the economic and financial rather than the technical phases of mining. As a representative of the bond holders of the Canada Copper Corporation he participated in the reorganization and rejuvenation of the Granby Consolidated Copper Company. He does not golf and does not expect to; but he fishes, hunts ducks, and is a trap shooter of no mean ability. His hobby is the collection of books and documents regarding the early history of the Northwest.

It is Mr. Moulton's conviction that to keep up in his profession a mining engineer should do two things: Take a really active part in the affairs of technical societies and read the *Engineering and Mining Journal* habitually. He himself does both. Seldom is he absent from meetings of the M.&M. Society or those of the A.I.M.E. He has just been elected a director of the Institute. That the honor is deserved is no less certain than that the Institute will profit from his balanced judgment and wise counsel.

Prolonging the Life of the Smuggler Union Enterprise

Economic and Technical Problems Solved Since 1923

By ROBERT LIVERMORE
President and General Manager, Smuggler Union Mining Company, Boston, Mass.

TELLING of an old mining property situated in a district so well known as the San Juan region of Colorado does not promise a theme fertile in new technical thought or addition to mining knowledge, but it is hoped that this sketch of part of the life of a famous old mine may prove of interest as showing the recuperative powers of an apparently nearly worn out property, and of some of the methods used to bring about, if not its rejuvenation, at least its galvanization into a few more years of productive life. The Smuggler Union mine is situated some three miles east of Telluride, Colo., a mining center of former prominence and still active existence. Telluride is at the head of the San Miguel River on the western edge of the San Juan Mountains, about 400 miles by rail from Denver. The town lies in a level valley of real scenic beauty at an altitude of 8,700 ft., surrounded on three sides by towering peaks, and with a vista on the fourth side of cultivated mesas and the distant blue La Sal Mountains of Utah. The Bullion tunnel of the mine, where are situated the main mine workings, is at an altitude of 10,900 ft. and is reached by a splendid wagon road. One mile farther east, and 600 ft. higher, are the plant and workings of the Tomboy mine, and over the ridge, a mile to the west, are the Liberty Bell workings, now dismantled. Other well-known centers of the mining industry of the San Juan are Silverton, headquarters of the well-known Sunnyside mine of the United States Smelting, Refining & Mining Company; Ouray, near which is the Camp Bird mine, now idle except for leasers; Rico, a recent "come-back" into the class of active producers; and Durango, on the far southwestern edge of the belt, a thriving city of varied interests, in which is situated the smelting plant of the American Smelting & Refining Company, to which concentrates from Telluride and Silverton are sent. Nowadays all of these towns are connected by good motor roads, and except for occasional outbreaks of nature, when cloudbursts and landslides wipe out roads and rails, passage from one to the other is a matter of a few hours. Formerly dependence was had on rail, wagon, or saddle, all slow and circuitous, and even now the trails are used by those more leisurely inclined, and pack trains are encountered in the high places.

Bridal Veil falls and the power plant where 400 hp. is generated by the Smuggler Union company

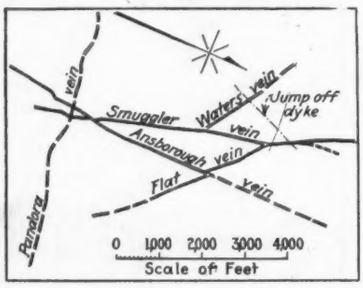
Prospectors were in the San Juan in the early 'seventies. In fact, the Spaniards antedated them by more than 200 years, but these latter found no gold and left only their names behind. San Miguel, Rio de las Animas Perdidas, familiarly called "the Animas"; Dolores, San Juan, and the like are their memorials. We hear of the prospectors being harassed by the Utes in the 'seventies until they were driven into Utah in the last part of the decade.

The first locations on the Smuggler vein were made in Marshall basin, where it outcrops at an altitude of 12,000 ft., in 1875. A ton of ore assaying $2,000 is said to have been shipped to Alamosa in that year. Development was slow though steady. In 1878, 200 tons was shipped, and in 1883, 100 men were working in Marshall Basin. In 1884 the Sheridan mine, one of the properties on the Smuggler vein, came to the fore with 1,400 tons of ore, including some concentrate, assaying from $50 to $225 per ton.

In 1890 the Rio Grande Southern was completed to Telluride from Ridgeway, the junction with the Denver & Rio Grande, and from that time on development of the camp was rapid. In 1896 400 stamps were operating

in the district and the annual production was $3,000,000, of which two-thirds was in gold.

Many mines were in operation around Telluride in early days, some of which were productive and profitable. However, in the first decade of the present century the number had narrowed down, by reason of consolidation or exhaustion, to three: the Liberty Bell, Tomboy, and Smuggler Union, to be joined later by the Black Bear. These mines were sufficient to support a prosperous community of 5,000 people, of whom half or more were employed in and around the mines: Today the field is much narrower, for the Liberty Bell has been closed down and dismantled for several years, the old Tomboy company closed and sold its plant and property last year, and the Black Bear has suspended operations. Perhaps 1,500 people now make up the population.



Sketch map showing the vein system at the Smuggler Union. Where the Flat and Smuggler veins touch the orebody is 10 ft. wide for 800 ft. along the strike

The class of labor is varied. Successive waves of immigration each have flooded the camp with their respective nationalities, from Cornish, Swedish, North Italian, and Greek, to the present floating labor supply, made up largely of Mexicans and even Indians. These latter are mostly of the Navajo tribe, who, it is said, came during a labor shortage, riding ponies, and with feathers in their long hair. Now, those that are left are "bobbed" and rubber-booted like the rest.

Complete records of the production of the Smuggler Union are lacking, but records and reliable hearsay give to the Smuggler group of mines in its 52 years of life a production of over $60,000,000. Today the yearly gross production, because of the greater tonnage, is nearly as great as ever, but the profits, owing to the lower grade of ore, are sadly less.

In the early 'nineties the various mines operating on the Smuggler vein were consolidated under the ownership of the present company, financed in this country and in England, which operated successfully for a number of years. In 1900 the control was sold to Boston interests, in whose hands it has remained since then.

Dating from the new ownership events bore hardly on the property. The miners' strike of 1901 to 1904 at times stopped and always hampered operations. In this strike, which was nothing less than guerrilla warfare, and is still vividly remembered, Mr. Collins, then manager, among other good men, met his death at an assassin's hands, and the mine suffered a siege and capture at the hands of armed strikers.

Snowslides, which are a special hazard of the steep-sided San Juan Mountains, damaged property every year and killed men once in a while, though the company never suffered as badly in this respect as did the neighboring Liberty Bell, which lost a score or more of men in one disastrous night. Fire has been the especial bane of the company. The buildings of the Bullion tunnel were burned in 1901, and 23 men were cut off from escape and suffocated by smoke drawn underground. In 1919 one of the two stamp mills was destroyed, and in 1920 the flotation plant with many lesser buildings was wiped out. The series of fires culminated last October in the total destruction of the mine buildings and tram terminal at the Pennsylvania tunnel, the lowest level.

Geologic Section Exposed by Canyons

The country rocks of this part of the Telluride Quadrangle have a simple geologic structure, little faulted or folded, and offering through the exposure made by the deeply cut canyons, a strikingly graphic geologic section from the bottom of the valley at 8,700 ft. to the top of the range at an altitude of 13,000 ft. The basal sedimentaries, sandstone and conglomerates of the Jurastrias are capped at an elevation of about 9,700 ft. by the first of the igneous strata, which lie above in a series of bedded deposits of andesite breccia and augite andesite nearly 3,000 ft. thick. These strata are capped by fragments of a rhyolite bed whose base lies so nearly uniformly at an altitude of 13,000 ft. that the height of mountains can be closely judged by observing its contact with the darker-colored andesites below.

The Smuggler vein is a fault fissure, striking a little west of north, which with its continuation to the north, the Humboldt vein, is said to contain the longest continuously mined oreshoot in this country, if not in the world. It has been mined without break for nearly 9,000 ft. longitudinally, and the vein with its branches is visible for four miles.

As far as is at present known, the ore-bearing horizon lies within the 3,000 ft. of andesite and breccia, for the vein in the capping rhyolite is barren, and the sedimentaries have not yet been penetrated. The bottom level is 500 ft. above the sedimentaries, so from present indications it would seem as though the ore horizon would extend at least this distance.

There are several branch and crossing veins, all of which have been productive to a greater or less extent. The Ansborough is a strong fault fissure which displaces the Smuggler from 10 ft. in the upper levels to 120 in the lower. This vein has been low in gold, but contains fair lead and silver content. It has been worked at intervals in times past, and is now being developed during the better prices of lead. The Pandora, a wide quartz vein containing erratic but rich shoots of gold ore, now supposedly exhausted, is chiefly notable as being the westerly extension of the famous Camp Bird. The Waters, the extension of the well-known Liberty Bell on Smuggler ground, is now worked out; and last, but not least, is the Flat vein, so called, which was discovered in 1915, and which has produced nearly 2,000,000 tons of ore since that time.

Of these veins the ones of interest to this discussion are the Smuggler and Flat veins and their junction called the Combined vein. Ore in the Smuggler has an average width of barely 3 ft. The vein has a dip of 79 deg. The Flat vein shown in an accompanying sketch has an average width of 4 ft. and a dip of 60 deg.

The two veins do not cross, but from their junction run side by side northward, forming a single orebody about 10 ft. wide for about 800 ft. in length. This stretch of vein is called the Combined vein, and from it in the last three years major production of the best ore has come. Although in all other veins of the property the tendency has been for the grade of ore to decrease at depth, in this vein the metal content is about the same on the bottom level as in the upper levels. At the north end of the Combined vein the two separate, and their extension has not been explored. This condition has

The town of Telluride. For scenic grandeur nothing in America surpasses the San Juan Mountains in Colorado

Travel by pack train still survives in the San Juan region

Smuggler Union reduction plants. At the right the old stamp mill; at the left the new flotation plant

been disclosed in the development of the last three years, and it is an interesting conjecture what conditions will be found at greater depth, since the length of the junction has continually increased as greater depth has been reached.

Major Ore Metals are Gold and Silver

The Smuggler ore is characteristically a gold-silver ore with a little lead. The upper levels showed shoots of very rich ore, containing particularly free gold. As late as 1910 crude ore assaying several hundred ounces of silver per ton was regularly sacked and shipped, and several times within my recollection pockets of gold ore were encountered on which guards were posted. These occurrences have passed into history, unfortunately; but occasionally, even now, very rich but small pockets are encountered even at the lowest levels.

The characteristic mill ore of the Smuggler vein contains now about 0.12 oz. gold, and 6 to 8 oz. of silver, with about 1 per cent lead. The Flat vein also was richer near the surface, but its lead content has always been greater than that of the Smuggler ore. Fortunately, its gold content is somewhat higher also. Characteristic mill ore runs 0.20 gold, 1 to 4 oz. silver, and 1.5 per cent lead.

The Smuggler mine is operated through adits commonly called tunnels. The main adit, at which the mine buildings are situated at an elevation of 10,800 ft., is called the Bullion tunnel. Haulage is by electric locomotive, drawing from ore passes in 3-ton cars. The distance from portal to the main internal shaft is about a mile.

The Pennsylvania tunnel, by which access from surface to the lower workings is had, is at an elevation of 10,300 ft. This tunnel was driven by slow stages over a period of years, from 1900 to the present, and now extends to 7,000 ft. from the portal, 5,000 ft. of this length along the vein. Although much development and some desultory stoping was done from this level, the orebodies which it serves were not actively worked until the period under discussion in this article.

Flotation Plant a Modern Structure

As at present constituted, the Smuggler Union milling plant, situated at Pandora, two miles east of Telluride, consists of a crushing and concentrating mill and a flotation plant. The ore, after a primary crushing and sorting at the mine, is transported by a 4,200-ft. aërial tramway to the mill. Sixty stamps and a 7 by 6-ft. ball mill reduce the ore to classifying size, which is done in Dorr and Aikens classifiers, the coarse returning to the ball mill and to Marcy and Hardinge mills for regrinding. Concentration is done on Wilfleys, and the concentrates are cleaned on other Wilfleys. All tailings go to the flotation plant. Amalgamation, formerly a prominent feature, has, with the lessening of gold content, been simplified to pan amalgamation of concentrates from the cleaner tables. The capacity of the concentrator under present practice is 800 tons daily.

The flotation plant is of modern steel and cement construction. It was built in 1921 at a cost of $504,000 to take the place of one destroyed by fire. This plant was designed to take custom ores, as well as Smuggler ore, and is of about twice the capacity now needed.

The process at present used is simple, since no selective separation is made or, indeed, is feasible. A simple oil mixture with a small addition of xanthate is added to the product as it comes from the concentrator, which is then passed through a succession of cells of Callow type. The resulting concentrate is pumped back to two cleaner cells. After thickening, this product is mixed with the concentrate from the stamp mill, dewatered, and filtered on Portland filters. The cake passes over belts to the bins, whence it is mechanically loaded into cars for shipment to Durango. From two to three cars a day, equivalent to about 2,000 tons of concentrates a month, are made. The amalgam is retorted and the bullion sent to the mint. This product formerly constituted about one-third of the gross production, but now is somewhat less.

Good Recoveries by Concentration

Considering the somewhat complex nature of the ore and the comparatively simple treatment accorded it, the percentage of extraction of the metals is satisfactory. Based on the usual method of estimation, using net smelter and mint returns and calculated values of the tailings, 90 per cent of the gold and lead and 80 per cent of the silver is recovered. The concentration ratio is quite uniformly 10 into 1.

The power plant belonging to the company deserves mention. At 12,000 ft. altitude lies Blue Lake, a small body of water 200 ft. deep, which, with several other smaller lakes and tributaries, constitutes the water supply for power and milling. This water is lifted by two 100-hp. centrifugal pumps mounted on a barge over the rim of the lake, and falls through a 16-in. pipe line 2,000 ft. to the rim of the canyon above the mills. At this point the stream leaps over a cliff, to a descent of 364 ft. This makes Bridal Veil falls. In flood times it is an impressive sight, but it dwindles to a trickle in summer, when most of the water is used.

A power plant has been erected on the edge of the cliff which generates 400 hp.; then the water is piped to the mill 800 ft. below, where by means of a Pelton wheel, mechanical power to the amount of 400 hp. more is made. This is transmitted direct by line shaft to the stamps and tables. In addition the company buys from 500 to 1,000 hp. from the Western Colorado Power Company, the transmission lines of which reach the property. Water supply for the mill is tapped from the main pipe line ahead of the Pelton wheel. The total power generated in the company's plant amounts from 800 to 1,000 hp. It is generated at an average cost of 9 mills per kilowatt-hour, as against 11 to 15 mills for purchased power.

Pittman Act Factor in Operations

Following the discovery of the Flat vein in 1915, and its subsequent development, the mine enjoyed a period of several years of appreciable operating profits; but as a consequence of the destruction by fire, to which reference has already been made, and other causes, capital expenditures were large. After the expiration of the Pittman Act in 1923, with its accompanying drop in the price of silver, the operations showed a loss; and the continuance of losses for several months placed the property in serious financial position. In October, 1923, it became evident that radical steps would have to be taken; and it seemed likely that the mine would be closed down and the assets liquidated for the benefit of creditors.

Summing up the situation at that time, the directors of the company found, on the dark side, debts aggregating more than it seemed likely would be recovered from the ore or sale of plant and effects; continuing losses in operation; an alarming paucity of known ore reserves, in

effect about four months' run; and a woeful lack of ready cash. Against these might be set a good plant; some accounts receivable convertible to cash, but in amount not known; a fully stocked warehouse; and last, but not least, the co-operation and good will of the creditors of the company, and an organization ready and willing to pitch in and make things go.

A balance between favorable and unfavorable factors certainly did not make the situation seem very hopeful, but it was thought that by careful management operations could be made to pay at least long enough to realize more from the ore than by immediate sale; and the knowledge of how tenacious of life are many of these old productive properties even when apparently on their last legs, determined the decision to continue operations. Operations since this decision was made fall into three periods: (1) Liquidation of debts. (2) Construction and development. (3) Increased production.

1. Period of Liquidation

It was recognized that strenuous measures must be taken to get the company out of debt and restore its credit, and to this end all superfluous expense was cut to a minimum. In this connection it is surprising to find how many expenses considered in prosperous times to be necessary are non-essential. It was expected frankly to ignore maintenance of plant and equipment beyond the immediate necessities, to exhaust warehouse stock, and to curtail development; and, in the event, fortunately no serious impairment under these heads was experienced.

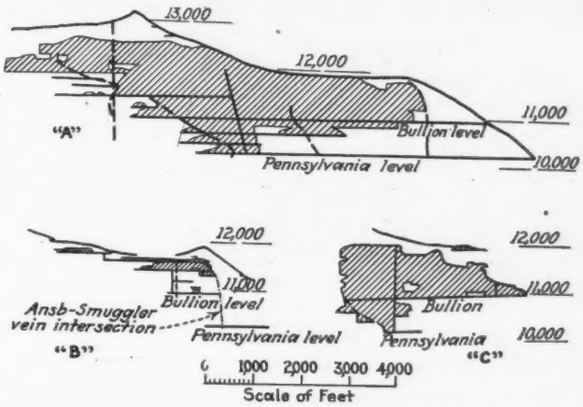
The period of liquidation was ended in a little more than a year from its undertaking, with the payment of all past-due accounts. The factors which made this possible were: successful collection of accounts due, which were perhaps naturally paid more willingly to a going concern than to a salvage operation; reduction of warehouse stock by one-half—which in effect disclosed that a needless surplus had been carried—which thereby was put into circulation; leasing of the more inaccessible blocks in the mine, such as pillars of shipping grade ore which had been left to support ground, which when worked by leasing methods added materially to the production; development of new ore, to which the ground explored under the curtailed program responded so well that 180,000 tons was produced from reserves which had been estimated at less than half this figure; a favorable price received for lead, which partly made up for the lower price of silver; and, lastly, close attention to economy and efficiency in operating methods. The latter clause, of course, covers a world of detail to which the successful outcome of this period was largely due. It was made possible only through the efforts of a loyal and an efficient staff.

2. Period of Construction

At the end of the first period the question again was presented whether at this point it was better to shut down now that the company was clear of local debt, or to try to realize more from operations. On the unfavorable side were apparently exhausted ore reserves, equipment in need of repairs and replacement, and depleted warehouse stock; on the favorable side, a few thousand dollars of operating capital, restored credit, and the rather intangible asset of confidence induced by the successful outcome of the last year's operation.

Two principal features determined the matter in favor of continuing: (1) That there were large areas in the upper levels of vein not shown in the reserves as ore, which it was thought might be made to pay under the changed conditions. On much of this, development by drifting had been done, and in some stopes had been prepared for extraction. (2) That there existed below the Bullion level a very large area of untouched ground both on the Smuggler and Flat veins which had been assumed to be unprofitable and for which the expenses of opening would have been so great that it was impracticable to attempt it during the first period.

All ground below the Bullion level at this time was



Stope maps on various veins. "A"—Smuggler Combined and Humboldt veins. "B"—Ansborough vein, longitudinal section. "C"—Flat vein

more or less inaccessible. The Pennsylvania tunnel was caved near the entrance, and the Internal Shaft No. 585 was disused and in bad condition below the Bullion level. This shaft, originally driven as an inclined raise on the Flat vein, extended from No. 1 level, 1,000 ft. in the plane of the vein above the Bullion, to 400 ft. below that level, and thence was connected by a manway to the Pennsylvania level 750 ft. below the Bullion. It was used entirely for hoisting men and supplies and was not used for ore.

Ore Developed in Lower Levels

An exploratory trip was made through this shaft and the manway to the Pennsylvania and intervening levels, and in spite of difficulties of travel through loose muck, broken timbers, and accumulated mud and water, enough evidence was collected to warrant continuance of operations.

The problem presented was to develop a reserve capable of producing at least 300 tons daily from the lower levels, and meanwhile to maintain production and pay for operations from the rapidly diminishing ore reserves of the upper levels. The steps taken were as follows: No. 585 Shaft was reconditioned for the 400 ft. it extended below the Bullion level; and as soon as possible the 350 ft. of manway below that point was reamed to the full size of the shaft; timbers and rails were set; and connection by hoist was established with the Pennsylvania level. The level itself was straightened, 1,500 ft. of ditch was dug, caves were cleaned up, timbering was replaced and strengthened, heavier rails were laid, trolley wires were strung, and the whole level generally was put in condition for motor haulage. Stations were cut at 12, 13, and 15 levels and drifts started on both the Smuggler and Flat veins in both directions.

At the portal of the tunnel a bunk and boarding house for sixteen men, a blacksmith shop, bins, sorting tables, and tramway terminal were erected and a crusher plant

was installed. This unit was designed for 200 tons, but, after subsequent improvement, proved capable of handling three times that tonnage. A motor-controlled aërial tramway, supported by five towers, was stretched for the 2,800 ft. to the mill. This work was started from the bare rock in November, 1924, and by March, 1925, the first ore was sent to the mill. Of the difficulties of construction during an exceptionally severe San Juan winter it is needless to speak. The cost of all outside construction, including buildings and tramway, was to this point in round figures $27,000, a figure which it was

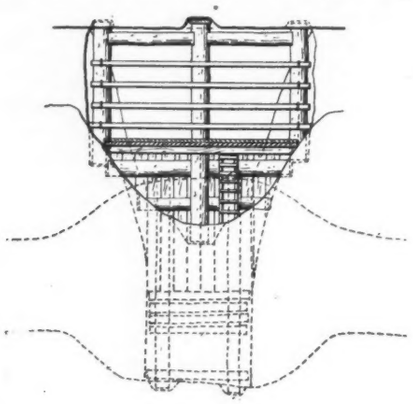


Fig. 1—Plan section at the grizzly

possible to attain only by the use of old material, much of which had been discarded as junk.

By June, 1925, about one-half of the tonnage, some 250 tons daily, was being produced through the lower workings, all costs of construction and operating had been paid for from production, and the ore reserves had been increased to 190,000 tons.

3. Period of Increased Production

It has been said that the grade of the ore in both the Smuggler and the Flat veins diminishes with depth. It was found that, although a small tonnage of ore of about the same grade as in the upper levels had been opened and could be mined profitably, a larger tonnage of ore of doubtful value had been opened by the same operations. Therefore it became a question as to how much of this ore to include; and the obvious answer was to increase the tonnage and, by so doing, lower costs and make the marginal ore profitable.

From July, 1925, all efforts have been directed to increase of production to the full capacity of the mill, and at the same time to maintain the grade of the ore at a profitable level. This was not done at once, and there have been many setbacks. The story is summarized in the figures given in the annual reports of the company for the fiscal years ended April 30, 1925, 1926, and 1927, which follow:

	1925	1926	1927
Gross extracted value, per ton	$6.25	$6.06	$6.23
Freight and treatment	1.08	1.33	1.33
All other expenses	4.88	4.97	4.65
Total cost	5.96	6.30	5.98
Tonnage	177,720	218,449	253,975

By this statement it will be seen that the grade of the ore was nearly maintained, that the tonnage was increased by 40,000 tons in 1926, and 35,000 tons more in 1927, but that costs started to come down in the last-named year.

The explanation of the poor results in 1926 is found mainly in the difficulties encountered underground. A partial solution of these difficulties is reflected in the better results for 1927, and is the subject of the concluding part of this article.

The old method of mining Smuggler ore was, invariably, by the filled stope. Drifts were usually driven 17 ft. high so as to include the cut-out stope, and timbers followed the face closely. Stulled pockets and chutes of the usual type were put in at 50-ft. intervals; the pockets were lagged over, and at first cribbed, and, later, rock mills were carried up with the stope. The gangue usually supplied the fill, but if not, the walls were shot into. This method had the advantage of giving good control over the grade of the ore and of keeping the ground safe. It had the obvious disadvantage of producing small tonnage, and small reserve supply of broken ore.

Shrinkage Method Adopted

When the Flat vein was opened, its greater width made possible the adoption of the shrinkage method in mining, in which the stope moved upward on the broken ore which was drawn through chutes spaced 20 ft. apart. The "swell," amounting to about one-third, was drawn while the stope was in progress; the reserve, the remaining two-thirds, as needed. As there is much dilution, sorting is necessary, and this was at first done on grizzlies over the cars and in underground stations. Later a belt washer was constructed at the mill, and still later sorting on tables at the portals of the mine was resorted to. By this later method, now in use, 17 per cent of the run-of-mine rock is discarded as waste.

When, subsequent to the reconditioning of 585 Shaft, drifts had opened up the ground on the Flat and Smuggler veins in the lower levels, two conditions were disclosed which had not existed in the upper levels: first, that the junction pitched at a flat angle from north to south, making long stretches of loose and heavy ground both in the levels and stopes; and, second, that beyond (north of) the junction the two veins traveled side by side for a distance which has increased with depth to a length of 800 ft. on the lowest level, and making an orebody 10 ft. or more wide which also creates heavy ground when stoped. Before this condition was recognized much time and money had been spent in trying to maintain, by timbering, ground which no timber could support, and in mining all over again at the chute mouths boulders of waste which had choked the draw. To combat these conditions two expedients were adopted: First "pillaring" the instant the ground appeared at all heavy in the stopes, and leaving pillars between chutes on the level; and, second, the institution of the plan of providing bulldozing chambers on grizzlies above the levels. The first method has always been usual and necessary in the mine. It was simply systematized, and pillars were left "on suspicion" at no matter what cost in ore left behind.

The second method was instituted by H. S. Worcester, superintendent of the mine (to whom acknowledgment is given for the following description), after a study of the method used at the Sunnyside mine. It is a modified adaptation of that system. In the illustrations the longitudinal section of a stope showing chutes, pillars, stope drift, and manways is shown. Fig. 1 gives the plan section at the grizzly, and Fig. 2, a longitudinal and cross elevation of the pocket and grizzly construction.

In opening a stope, the procedure is as follows: Manway raises are carried up and pockets started, beginning at No. 1, Fig. 3. From the top of No. 1 pocket the stope drift is run in both directions, other pocket raises being

carried up at the same time. As soon as the drift is broken through to the south manway, this is used for access to the drift, which is broken through to each raise in turn until the north manway is reached, the pockets being left full of ore. Then grizzly stulls and the upper portion of the grizzly are placed and the ore is drawn from the pocket to permit completing the lining down to the chute. After the grizzlies are in position, raises over control pillars are carried to open the stope, and these are followed by stoping to size.

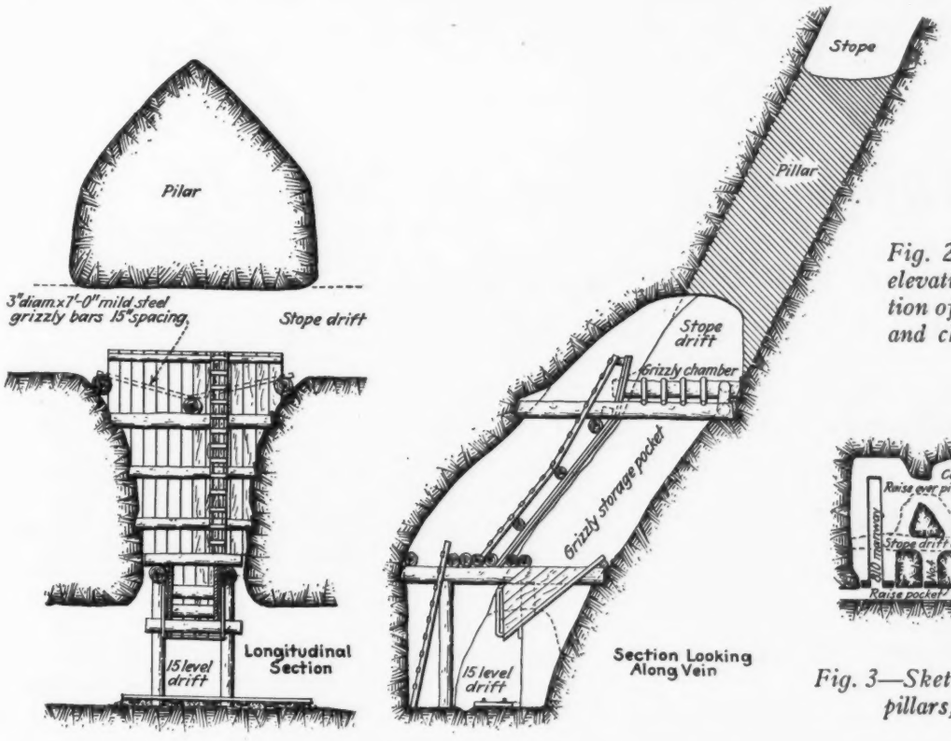


Fig. 2 — Longitudinal and cross elevation showing the construction of the storage pocket, grizzly, and chute above the drift level.

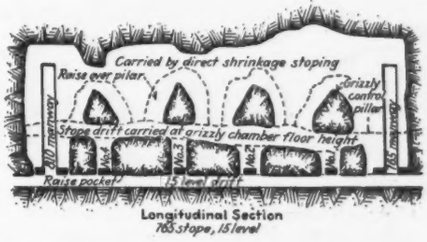


Fig. 3—Sketch of stope showing chutes, pillars, drifts and manways

Faster Drawing and Extraction

The principal advantage of this method lies in the increased speed of drawing, which in turn results in faster mining. It has been found by direct comparison that from one such stope over 400 tons per day can be drawn, as against, at most, 200 tons under the plain chute system.

For grizzly bars, as much old material is used as possible; old stamp mill stems are the best. The bars can be salvaged and used again.

It has been found necessary to carry the stopes as separate units, leaving 20-ft. pillars between. These pillars are afterward wholly or partly recovered. The stopes are carried 225 to 250 ft. long, and in the north end of the mine, where levels are 250 ft. apart, they have been carried for that height. From eight to ten months is needed from starting at the drift to completion.

This method of mining would seem to be extremely expensive. However, experience has proved the contrary. The disadvantages are rather in the time consumed in getting started and the large amount of ore tied up in broken reserves while the stope is being carried up. An estimate made of all costs applicable to a typical stope shows that, including every cost of development, fittings, and stoping, 41,690 tons mined cost $16,163, or 38.7c. per ton; and still lower costs were possible for the remaining tonnage, amounting at the time the estimate was made to about 20 per cent of the total, on which preparation costs had been paid.

Wherever possible, underground work is done on contract. This system, always in use, has been greatly extended and is preferred by both company and men. Stoping is contracted on the fathom basis, and all pillars left are considered as area stoped. Rates run from $7 to $8.50 per fathom. The average daily wage to the miner is approximately $8.25. Drifts and raises are paid for at from $6 to $8 per foot; tramming is paid for at from 15c. to 25c. per car (1-ton capacity) on intermediate levels, and at 35c. per car (3-ton capacity) on main haulage levels; timbering from $3 to $4.50 per foot, and various prices are established for chutes, square sets, and special work. Ore mined by contract amounts to twenty tons per machine shift.

The following summary shows the operating costs for a typical year. The costs given include every expense at Telluride, including local taxes, insurance, and construction, and exclude only Boston office expenses, depletion, and depreciation:

Ore Extraction	Per Short Ton	Ore Reduction	Per Short Ton
Mining	$1.194	Crushing	$0.092
Timbering	0.460	Flotation plant	0.368
Hoisting	0.057	Concentrating mill	0.610
Tramming	0.766		
		General charges	0.398
Cable Tramway		Development	0.396
Smuggler tramway	0.131	Construction	0.037
Pennsylvania tramway	0.085		
		Grand total	$4.594

Since the end of the fiscal year, May 1, 1927, even better results than before have been obtained in respect to tonnage and costs, the former rising to the peak of 23,760 tons per month of milled ore, and the latter falling to $3.84 for all operating costs.

On Oct. 20, 1927, from some cause not explained, fire, the old enemy of the company, started beneath the tramway floor of the Pennsylvania buildings. This was not discovered until it had made considerable headway; but

even then might have been extinguished had not the high pressure of 300 lb. per square inch carried on the fire line burst the main by the water hammer caused by shutting off the valve too quickly in making a change of hose. In literally a few minutes there remained only the ruins of the plant.

This destruction had the effect of cutting off the principal supply of ore, and it was considered that the delay and expense of rebuilding, on the verge of winter, would be too burdensome. Accordingly, the task has been undertaken of converting the internal shaft from a man to an ore hoist, work which at this writing is nearly completed. That, however, is a story in itself; only the future will reveal the results.

It is not expected that the same tonnage and costs will be obtained, and inevitably much of the ground so handily served by the tunnel haulage to surface must be abandoned as available ore. However, the same spirit of endeavor exists as in former crises, and the best will be made of what at first seemed an overwhelming disaster.

Cyaniding at Midas, Nevada

Efficient New 75-ton Plant Erected and Operated by the Gold Circle Consolidated Mines Company

By Milo Carlston

Mining Engineer, Gold Circle, Nev.

THE mines of the Gold Circle Consolidated Company are at Midas, Nev., the nearest shipping point being Red House, on the Western Pacific Railroad, 33 miles distant. Winnemucca is 64 miles west and Elko 90 miles to the east. The property represents a consolidation of mines in the Gold Circle district made by Noble H. Getchell early in 1926. A 75-ton cyanide plant was completed in June, 1927, and about 100 men are employed.

The mill was designed by A. H. Jones of Salt Lake City, and although expected to handle 75 tons, from 90 to 100 tons has been successfully milled per day. Power is furnished by two Fairbanks-Morse, two-cycle, solid injection Y-type Diesel engines and is distributed electrically to the plant.

Ore is trammed to a 250-ton ore bin. Coarse ore is fed to a 24-in. by 12-ft. steel apron plate belt, from which sorters remove three or four cars of waste per day. The belt discharges into a No. 4 Telsmith gyratory crusher. Lime, 15 lb. per ton of dry ore, is added at the gyratory. Crushed ore and lime are conveyed to a 100-ton ore bin.

The equipment in the grinding section consists of a belt feeder, a 5 by 4-ft. Allis-Chalmers ball mill; a 16-ft. Dorr classifier, and a 5 by 14-ft. General Engineering tube mill. Ball and tube mill are driven by motors operating through Tex rope drives, which have given satisfactory service.

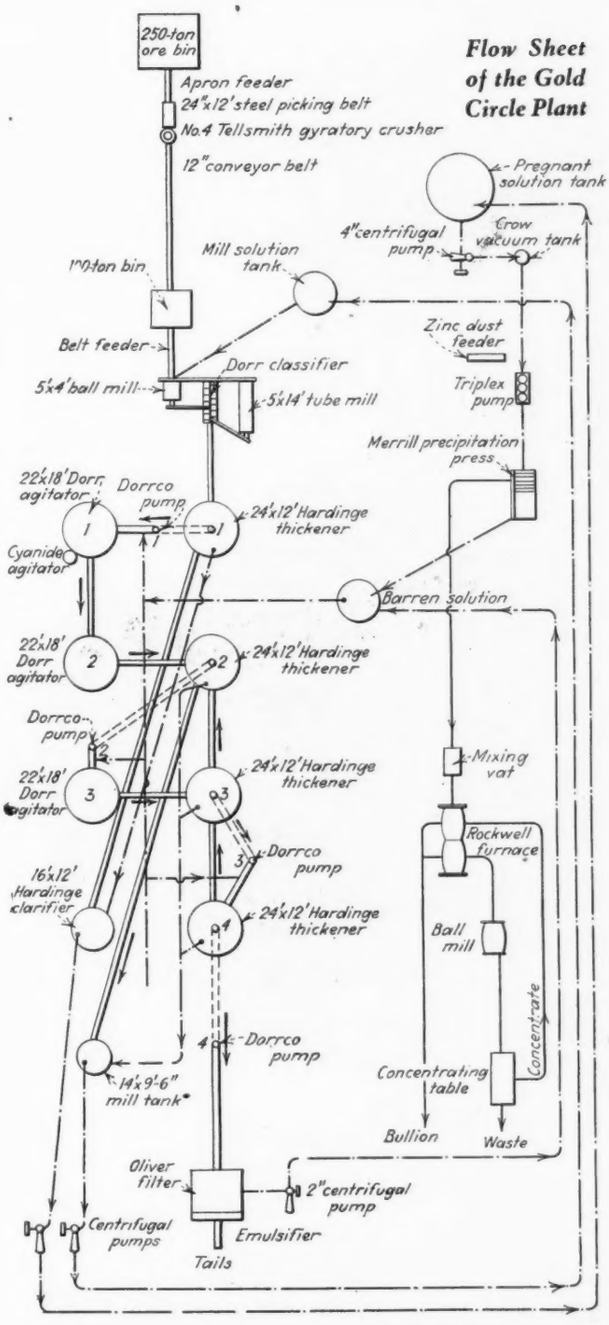
The ore is fed into the ball mill, ground in solution, and the pulp discharged to the classifier, which is in closed circuit with both ball and tube mills. The overflow from the classifier is laundered to No. 1 thickener. One man per shift is required to operate the grinding unit. Five-inch iron balls, totaling 100 lb. per day, are used in the ball mill; the tube mill requires 400 lb. of pebbles, which are supplied from the locality. These are not so hard as imported pebbles. Relatively less wear upon the manganese-steel liners has been observed since using the softer pebbles. An additional amount of lime is introduced at the grinders when found necessary. From 7 to 8 lb. of litharge per shift is added to the circuit through the tube mill.

The cyanide section is designed for countercurrent decantation, and consists of four 24 by 12-ft. Hardinge super-thickeners, three 22 by 18-ft. Dorr agitators, one 16 by 12-ft. Hardinge clarifier, one 14 by 9½-ft. mill tank, three centrifugal pumps, an Oliver filter, and accessory motors. The thickeners have given satisfactory service, and operating mechanism has stood every test imposed. The Dorrco diaphragm pump has handled pulps up to 59 per cent solids.

Overflow from the classifier is discharged into No. 1 thickener, the clear overflow resulting being the richest solution in the circuit. This solution and the filtrate (from below the false bottoms of the Hardinge thickeners) is sent to the clarifier and then to the pregnant-solution tank. The thickened pulp from No. 1 thickener is pumped to No. 1 agitator. Cyanide is added to the circuit at this point and the pulp diluted to 65 to 70 per cent water and sent successively through No. 2 agitator and No. 2 thickener, the pulp from the latter going to No. 3 agitator, where sufficient litharge is added to the circuit to prevent fouling of the solution. From No. 3 agitator the pulp flows by gravity to No. 3 thickener, and then to No. 4, where it receives a final wash before going to the Oliver filter.

The overflow from No. 4 thickener is sent to No. 3, and the overflow from the latter to No. 2. Barren solution is added at all three Dorrco pumps. Overflow from No. 2 thickener, together with the filtrate from No. 2, 3, and 4 thickeners, goes to the mill tank, from which it is pumped to the mill-solution tank. This solution is the second richest in gold content and is used in the ball mill. No. 4 Dorrco pump takes the pulp from No. 4 thickener and delivers to the Oliver filter, at which point the pulp is given a good washing before being discharged to the tailing pond. Recovered solution is pumped to the barren-solution storage tank.

The precipitation section consists of a pregnant-solution tank, a Crowe vacuum tank, 4-in. centrifugal pump, zinc-dust feeder, triplex pump, and Merrill filter press. The worker in charge of the grinding section is also in charge of precipitation. Pregnant solution is pumped to the Crowe vacuum apparatus by the centrifugal pump; and, after de-aëration, zinc dust is added. The mixture is pumped by the triplex through the filter press. Every fifteen days the filter press is cleaned up and the



Flow Sheet of the Gold Circle Plant

precipitate mixed with borax, soda, and silica and reduced in a Rockwell furnace, the "table concentrate" resulting from the slag of the previous cleanup being added to the charge. Bullion has a content of 71 gold and 874 silver per 1,000. It is cast into bars and shipped to the smelter. Production plus tailing value indicates a recovery of about 93 per cent of the gold and silver in the ore.

Consumption of supplies per ton is as follows: Cyanide, 1 lb.; balls, 1 lb.; lime, 15 lb.; pebbles, 4 lb., and litharge, 0.45 lb. The mill payroll is the largest cost item. The crew consists of one sorter, one helper, three ball-mill men, three solution men, two mechanics, and a mill foreman, or eleven in all. Cost of milling in September, 1927, was $2.861, of which 53.6c. was for grinding, 87.1c. for solution treatment, 71.2c. for general expense, and 74.2c. for power. The grade of the ore milled is from $15 to $20 per ton, the ratio of silver to gold being close to 12 to 1. The ore is a white quartz containing several bands or ribbons of black material, which appears to contain the greatest proportion of the precious metals. Specimen rock indicates that the gold is free, but in the lower-grade ore, gold and silver are in intimate association. Sulphur is present in pyrite, and some of the silver possibly occurs as a sulphide.

Nickel as an Alloy in Steel Making

NICKEL is the most widely used alloy element in the manufacture of steels, according to *Black and White* for March. It is outstanding because of the fact that it combines with or is dissolved by the iron in any proportion and does not normally form a carbide. Therefore, as would be expected, nickel increases the strength and toughness of the steel without material increase of hardness. The nickel content of commercial nickel steels varies from as little as ½ of 1 per cent to as high as 46 per cent and one commercial alloy even contains 80 per cent nickel and 20 per cent iron.

On account of the entrance of alloy-steel scrap, and the fact that nickel is not lost or remelted, much carbon steel, to which no nickel has been intentionally added, will carry from a few hundredths up to say ¼ of 1 per cent nickel (and often appreciable amounts of chromium). If the presence of this adventitious nickel is not recognized, erratic results may be met on heat treatment because of the marked effect nickel exerts on the critical range.

Nickel lowers the critical range of the steel and 1 per cent nickel will lower the Ac_1 range about 40 deg. F. (25 deg. C.), as a result of which nickel steels when heat treated are usually treated from a lower temperature than carbon steels of like carbon content. Each 1 per cent nickel up to 5 per cent raises the tensile strength about 5,000 pounds over the corresponding carbon steels without loss of ductility or material increase in hardness.

Nickel steels with a nickel content under 1 per cent are used almost wholly for carburizing; with a nickel content from 1½ per cent to 5 per cent the steel may be used for carburizing structural parts or automotive parts such as gears, pinions, cam shafts, depending on the carbon content. When from 20 to 25 per cent nickel is added, the steel has considerable resistance to corrosion and is used where resistance to rusting is of major importance. Steels with 25 to 30 per cent nickel are used as the heating elements in household appliances such as irons and toasters, but these are only satisfactory when run below a red heat. The steel containing 36 per cent nickel is known as invar; at atmospheric and low temperatures it has the lowest coefficient of expansion of any known alloy, and hence has innumerable applications. Steels with 46 per cent nickel have practically the same coefficient of expansion as glass and have displaced platinum as lead wire in incandescent lamps. Finally, there is an alloy with 80 per cent nickel and 20 per cent iron which has an extremely high magnetic permeability with low magnetizing force.

Nickel which is dissolved by the iron to produce an alloy of increased strength and toughness, makes an excellent combination with chromium, with which it forms a carbide which imparts hardness to the alloy. Therefore, the nickel-chromium steels are of wide application. It has been found that generally from two to two and one-half times as much nickel as chromium gives the best results.

Left — Bench before blasting. It is about 125 ft. high and 250 ft. long. Below—Just after the blast, in which 3,703 kg. of explosive was detonated

Blasting in the Dalmatian Portland Cement Rock "Mine" in Yugoslavia

Left—After the smoke and dust had cleared away. About 75,000 tons of rock was broken

Concreting the Collars of Churn-Drill Holes Before Blasting

EXPLOSIVES are extremely expensive at the plant of the Dalmatian Portland Cement Works Company, Ltd., near Spalato, Dalmatia, in Yugoslavia. Consequently every effort is made in the open-cut-mining operations to minimize the quantity used per ton of rock broken. One measure to this end is to bottom the 6-in. churn-drill holes about 20 ft. above the horizon to which it is planned to break. Whether this will prove satisfactory in the long run remains to be seen. A more certain measure for economy is the careful loading of the holes and the final closing of the collar with concrete to a depth of from 5 to 7 ft.

The company owns an unusual deposit of marly limestone, the composition of which is such that it contains all the necessary constituents of portland cement in the correct proportions. The mine is situated close to the cement works on the coast of the Adriatic Sea. Output of finished cement is about 600 tons per day. The plant is well equipped with modern machinery for transporting, grinding, calcining, bagging, barreling, and loading the product, which is recognized as being of superior quality.

Mining operations are also efficiently organized and modern methods are in vogue. The bench is from 120 to 150 ft. high. Churn-drill holes sunk by Keystone "cable" machines from the United States are placed from 15 to 25 ft. back from the vertical face, and are spaced about 16 ft. apart. Recently one blast was fired that broke nearly 75,000 tons of material from a face 250 ft. long and 125 ft. high. The following shows the manner of loading a typical 6-in. drill hole: beginning from the bottom, 10 ft. of gelatine blasting dynamite from Switzerland, used because of the water present in most of the holes; 20 ft. of Titanit, an explosive consisting of nitrate of ammonia and TNT, made in Yugoslavia; 10 ft. of tamping material; 12 ft. of Titanit; 6 ft. of tamping; 8 ft. of Titanit; 6 ft. of tamping; 5 ft. of Titanit; 6 ft. of tamping; 7 ft. of Titanit; 5 ft. of tamping; 6 ft of concrete, poured into the hole and allowed to set. Cordeau safety detonating fuse, manufactured in the United States by the Ensign Bickford Company was used to fire the entire set of sixteen holes simultaneously. The charge for the entire blast consisted of 2,860 kg. of Titanit and 843 kg. of gelatine dynamite, or 3,703 kg. of explosive. The managers of the company believe that the sealing of the holes with concrete added to the effectiveness of the explosion and permitted lighter charging than otherwise would have been needed.

The photographs on page 534 show the bench before the blast, the blast itself and the broken rock after the charge had done its work.

Plan Revival of Russian Asbestos Industry

ASBESTOS is one of the most important of the Russian mineral exports. World consumption is rapidly growing, and production of graded asbestos in 1926 was almost twice the pre-war quantity. In spite of this increase there is a shortage in the world market, and prices are rising, especially for the higher grades. The chief producers and sellers of graded asbestos in the world market are Canada, Rhodesia, and the South African Union. The Soviet Union is also a large exporter, having large asbestos reserves. The Bazhenov mines form the principal Russian deposits.

According to the *Trade and Industrial Gazette,* an official publication from Moscow, the Russian asbestos industry began to develop toward the end of the last century; more than half the total production then went to the world market. Before the war Russia occupied second place, next to Canada, as an exporter of asbestos, but during the war the industry was cut off from the foreign market and was almost completely suspended. It began to be re-established in 1921. Production of 23,000 tons and exportation of 12,389 tons were recorded for 1913; these figures dropped to 7,932 and 5,634 tons, respectively, in 1923-24, from which they have risen gradually to 21,500 and 9,944 tons in 1926-27. . . . In pre-war years Russian asbestos went to a number of European countries and to the United States; at present nearly all of its production goes to Germany.

The Uralasbest Trust is preparing to increase production by 40 to 50 per cent by mechanizing processes, making capital investments to modernize factories, and the increased use of electric power. Government subsidies have been provided. In addition other mines are to be developed, particularly the Aspagash, in Siberia, already worked on a small scale; and deposits in the southern Urals will be investigated. These will be under the management of the Uralasbest, which will supply technical advice.

In an Early Issue

FRUGALITY and care in a mining and milling operation may be the key to technical and economic success. Mr. Jay A. Carpenter has written an article on recent work at the Flowery mine, near Virginia City, Nev., that is an object lesson to executives, engineers, and metallurgists, as an example of what can be done with a low-grade gold ore and a comparatively small daily tonnage. Owned and operated jointly by a mining engineer and the prospector who discovered the property, the Flowery enterprise is achieving an enviable technical success; it pays its workers well, and makes a substantial profit from ore carrying little more than $3 per ton. How this is done will be disclosed in Mr. Carpenter's article.

The Weakest Link; or, Saving Time in a Mine Examination

By Ira B. Joralemon
Consulting Geologist, San Francisco

Ira B. Joralemon

PLATO was one of the first to remark that the strength of a chain is the strength of the weakest link. It is easy to forget this obvious bit of philosophy in many of the affairs of busy lives; and in none more easily than in examining mines. If engineers more generally took Plato's saying as their guide, the time spent in examinations would be greatly reduced, and, also, the features essential to making a correct appraisal would be unencumbered by details which may be true but which have no real bearing on the question.

The problem of how thorough an examination should be is a puzzling one. Owners of properties nearly always think the engineer is too hasty. They bitterly, and now and then justly, criticize the examiner who makes a decision after an inspection of a few minutes or a few hours. In the minds of most of them is a necessary connection between physical exertion and correct mental conclusions. Few prospectors or mine operators will complain of even an adverse report if the engineer has climbed every raise and mountain top in sight so rapidly that he and his guides have their tongues hanging out and their minds numb with exhaustion. Those for whom the report is made are less anxious for a long examination or a detailed report, for every day means more dollars from their pockets. But it is to be feared that even many prospective buyers value the looks and size of a report and the pleasing color scheme of the maps that accompany it more than they do the brief paragraph that settles the matter.

A mine examination is simply a process of testing the successive links of a chain of observed facts. As soon as any link is found to be too weak for the purpose it must serve, the examination is over. Any further time spent confuses the issue and wastes the money of the client.

Of the many findings that should cut short an examination, inadaptability of the property to the needs of the client is one of the most obvious. If the examination is made for a company so big that only a profit of half a million a year or more will have an appreciable effect on dividends, a 3-ft. vein of $10 ore can be eliminated at a glance. The fact that careful operation might yield a profit of a few thousand dollars a month has no bearing on the subject. A tactful or kind-hearted engineer may suggest to the owners of the property the names of people who may be interested in their mine; but in fairness to his clients he must not waste any time sampling or studying costs or geology. If the clients have only a limited amount to spend, and so must try several properties that can be proven for a small sum, any expensive gamble should be discarded off-hand, even if it looks attractive. A week's geological work might have disclosed the possibility of finding a faulted orebody by sinking a 1,000-ft. shaft, but this does not interest such clients, unless they want to play the part of middlemen. To protect those who employ him, an engineer must in all cases know what they want and what they can afford to take. Usually, a short talk with the owners of a property will show whether or not it is of a type that may suit his clients, often making the examination unnecessary. If the answer is negative, as soon as he sees that the property will not meet the requirements, the engineer cannot honestly look further.

The price or terms asked for a property often make it advisable to cut short an examination. Frequently the price of a developed mine is asked for a raw prospect. This variety of shortsightedness on the part of property owners has been notably common in the Mother Lode section of California, and is probably one of the most important reasons for the decline of mining in that state. A demand for a large cash payment for a slightly developed property will in most cases make it inadvisable to proceed further. There are exceptions to this rule, when the history of near-by mines or some unusual geological features make it safe to count on much additional ore. The time required before payments must be made should of course vary with the amount of development that must be done to throw light on the future of the property. Usually, the specified time is too short. Even with apparently simple geological and operating conditions, unexpected delays are likely to occur, and leave the optionees in the unenviable position of begging for an extension of time when the optionors know that money already spent makes it almsot impossible to withdraw. As soon as an engineer sees that the time offered in an option is not sufficient for the necessary work, a few hours' study will tell him whether he should ask for better terms or definitely give up the examination. Occasionally the total price asked for a property is so high that further consideration is not worth while. If a Uath Copper price is asked for a nice little lease, nothing is to be gained by finding out just how nice the lease may be. But if sufficient time is given before payments are

required, a seemingly high price is seldom cause for cutting short an examination. If the owners are reasonable enough to grant ample time, they can usually be persuaded to cut their price to one that is fair.

A brief trip underground and a study of mine maps often will reveal the fact that, even if the owner's assay value and estimated cost are accepted, it has cost a dollar and a half to find every dollar's worth of ore. In such cases re-sampling and careful study are not justified. The owner's estimates are seldom overly conservative, and may be accepted for the time as giving the property all it deserves. The problem then becomes one of geology. If a preliminary study of the structure and ore occurrence gives the impression that the early development was not well planned, or that it has not progressed far enough to yield representative results, the property may merit more careful geological study. If the ore is apparently bunchy, selective mining may turn failure into success. But too much optimism is dangerous in considering a mine in which previous operators have not found enough ore to pay for the hunting. Even the prospector who most scorns geology and all varieties of science seems to have an uncanny faculty for doing his development in the best place. The road of the geologist who tries to "show up" the old-time miners is indeed rocky.

THE problem of how thorough an examination should be is a puzzling one. Owners of properties nearly always think the engineer is too hasty. They bitterly, and now and then justly, criticise the examiner who makes a decision after an inspection of a few minutes or a few hours. . . . A mine examination is simply a process of testing the successive links of a chain of observed facts. As soon as any link is found to be too weak for the purpose it must serve, the examination is over. Any further time spent confuses the issue and wastes the money of the client.

The history of the district in which a mine is situated may help an engineer to reach an early decision as well as the history of the mine under consideration. Orebodies seldom grow alone. If there are no other prospects, and if no obvious general mineralization occurs in the neighborhood, there is little chance of developing even a moderately valuable mine. If other mines near by have played out at shallow depth or have passed into lean material, perhaps below a zone of surface enrichment, the chances are that the new mine will have a future as disappointing. A geological survey or other report that tells about the district is, therefore, of the greatest value. But except for the history and general geology, it is not safe to put too much reliance on such reports. New developments may have shown some reason why the mine in question may differ from surrounding mines; or in a general examination, perhaps only a reconnaissance, the earlier observers may have overlooked important possibilities. Nearly all the properties an engineer now visits have been condemned by half a dozen others. Unless he keeps an open mind and relies on his own observation he will seldom find a mine.

Transportation Often Decisive Factor

The relation of character of ore to transportation facilities may quickly convince an engineer that he would be wasting his time on a long examination. Ore is often much too lean to stand the cost of hauling to a custom treatment plant. Then if proved or probable reserves do not justify erecting a plant at the mine, it has no value. If the mine is far from a railroad, the cost of hauling supplies and metal or concentrates may be too great, even if a plant is built at the property. Sometimes a high-grade product near a railroad has no value, owing to market conditions and the location of fuels, fluxes, or factories for making finished products. For instance, a fairly rich zinc-carbonate ore is valuable only in certain parts of the country. High-grade iron ore is in many places worthless, and may continue to be so for a dozen years or more. Coal can be profitably exploited only under relatively favorable conditions. However, before definitely condemning a mine because of the character of the ore or the locality, an engineer should make allowances for future developments in metallurgy and transportation. In doing this he should bear in mind the fact that carrying charges soon double the investment. Unless it is likely that an ore will become valuable within a few years, it is usually cheaper to pay a higher price for the mine after it is certain that a profit can be made.

An engineer often sees at once that 100 ft. of development work will be much more useful than a thorough examination. A short crosscut may develop a vein beyond a fault that had been overlooked in old workings. A drill hole or two may show whether or not the sulphide zone under an iron-stained porphyry outcrop contains copper in paying quantity. Surface trenching may prove or disprove the continuity of mineralization along a shear zone or vein. Or a test pit may reveal the fact that a limonite outcrop in limestone passes in a few feet into a lead carbonate orebody.

In many such circumstances careful geological work might give nearly as reliable information at far greater profit to the engineer. Detailed mapping often makes a suspected fault a certain one. Microscopic study of an outcrop may prove to the satisfaction of the examiner that lead or copper sulphides, as well as iron, were present in the primary material that was oxidized to an iron capping. Slight alteration of wall rocks may show that a vein or mineralized shear zone continues even though the outcrop is covered. Painstaking geological study that reveals such facts quite frequently is of the greatest possible value.

But if the same information can be had at approximately the same cost by underground work, the engineer must regretfully tell his clients that what they need is a hole in the ground and not an elaborate report. He may seem to be making a casual examination, but the interests of his clients forbid more thorough work. A report based on a month's detailed study will convince only those who can follow the technical reasoning, whereas a vein exposed by a crosscut is patent to anyone who can swing a pick. The links in the chain of evidence thus far discussed can usually be tested quickly. If they are satisfactory, the more difficult work begins. The time necessary for sampling, geological mapping, study of methods of mining and treatment, and probable costs varies with every property visited. Each of these phases of the examination must be taken up in turn, in just sufficient detail to give the information desired. Too much time spent on any one item wastes the money of the client

and makes a correct conclusion more difficult, by exaggerating the importance of one link in the chain.

In nine out of ten examinations only a few rough check samples, or no samples at all, need be taken. If underground work has not progressed to a point where ore developed is likely to be representative of new ore that will be found, it is foolish to waste a lot of time and money in ascertaining the grade of the exposed ore. Even if this ore is likely to be representative, it is seldom worth while to do careful sampling unless the quantity of ore developed is reasonably great. In most such cases grade is not the link of the chain that needs testing, but tonnage. If it is uncertain whether there will be 1,000 or 1,000,000 tons, the question whether the ore is worth $8 or $9 per ton is purely academic.

Often the record of shipments is a much safer index of grade than any amount of sampling. A few samples in a bottom of a drift to prove the ore has not been cut off, together with smelter returns from a stope above the drift, are just as informing as a long series of channel samples.

Sampling that is too careful often given a wrong impression of the degree of accuracy of the examination as a whole. When the grade of ore is established to a tenth of a per cent, uncertainty as to whether dilution in mining will be 5 or 10 per cent, and whether the determined grade represents 10,000 or 20,000 tons, is often lost sight of. Accordingly, time spent in making an estimate of grade far more accurate than estimates of other factors in the examination is totally wasted.

There are of course instances in which the greatest possible care is necessary in sampling. If a great tonnage of low-grade ore is developed, on which the margin of profit will surely be low, a slight mistake in the estimate of grade may be fatal. In such a property there are uncertainties enough at the best. Mining grade is one thing that can be accurately determined, and this should be done at any expense. If a payment must be made for a property, or a large sum appropriated for a road or treatment plant, the engineer should make sure that the value of ore developed justifies the expenditure. He must then adopt all possible safeguards in his sampling.

If even a small amount of already developed ore is likely to be fairly typical, careful sampling of this ore may be necessary to show whether or not further exploration is advisable. In short, when the grade of the ore that can be seen is judged to be a vital factor in arriving at a decision, sampling becomes the most necessary part of the examination. When the contrary is true, little time need be spent on sampling.

As always, the interpretation of samples in making an estimate of developed ore requires more skill than the mechanical operation of sampling. An understanding of the geology and a general idea of the probable method of mining must precede the estimate. Assays of all the material that will be mined must be included in calculating the grade, and must be weighted in proportion to the quantity of material they represent. A simple mathematical computation will give the cubic contents with an accuracy far greater than that of other factors in the estimate. Specific gravity must be investigated, with the realization that even if the cubic contents is exactly figured, the tonnage estimate is no more accurate than the specific gravity determination. With all the care that can be exercised, experience and a knowledge of the quirk in psychology or fate that always places irregularly spaced workings in those parts of an orebody that contain the most gold or silver or copper are indispensable.

A study of detailed geology is more often necessary in planning development than in an examination for purchase. Generally , a brief reconnaissance will solve the simple geological problems involved in deciding whether or not to buy or option a property. There are, of course, exceptions. These exceptions are becoming more common as easily discovered, shallow orebodies are exhausted and more expensive deep exploration must be undertaken to find new mines.

If complex faulting makes the correlation of exposures underground or on the surface uncertain, the engineer must devote care and time to solving the problems. Often a new property is in an old district, but on account of property lines the proposed work is far from developed ore. In such circumstances a detailed geological study is necessary to fix the depth and position of strata of veins. Surface exposure in beds which do not contain ore may throw light on deeper mineralization. The recent discovery of the North Lily orebody in the Tintic district in Utah is an outstanding example of successful long-range ore finding by thorough geological work.

It sometimes happens that the developed ore in a district is associated with a certain type of surface alteration. Then an accurate mapping of areas having similar alteration is worth while. Frequently a very slight structural deformation, that can be discovered only by a careful geological survey, is of vital importance. In certain oil fields a dip of only a few feet in a mile is the only guide to the location of productive wells. Accordingly there are many cases in which an attempt to cut short the geological features of an examination would be fatal.

The newly developed geophysical methods often help to solve uncertainties in the geological aspects of an examination. In areas covered by a shallow, fairly uniform mantle of soil or glacial drift, an examination without the use of such methods has already become an anachronism. With increasing experience, the field of geophysical methods is constantly widening. As yet they are of little benefit in most of the Western districts.

WITHOUT a thorough knowledge of the size and grade of the deposit, the geological conditions, and the physical character of the ore, an intelligent study of mining methods is impossible. Some of the worst mistakes in the history of mining have resulted from accepting false premises on these points. Several huge gold mining enterprises have foundered because of the assumption that bulk mining on a great scale would yield the same grade as the smaller stopes of former operations. Failure to foresee the effect of a well-known fault on a caving system has cost millions of dollars. The selection of open-pit mining where the orebody was better suited to underground mining nearly wrecked a great corporation; and an underestimate of the cost of drilling and breaking an ore postponed the success of another for at least a score of years, after millions had been spent in equipment.

Generally, the ore is too deep to effect the instruments as much as various extraneous influences, such as power lines, pipe lines, flow of underground water, or irregular surface contours. Even where ore comes near the surface, rock exposures are so common that a study of outcrops will usually give more information than a geophysical survey. But though these new aids of geology are thus far strictly limited in their application, they must always be considered as possible aids to an examination.

Mining Method and Metallurgy

A study of the mining method that is most economical need be undertaken only after the engineer is reasonably certain that there will be a fair amount of ore of workable grade. Then the system of mining will have a very important effect on the rate of production, the grade of ore that will be mined, and the cost.

In most small mines the proper method of mining is obvious. A more or less offhand estimate of the possible rate of production, mining cost, and dilution by waste from the walls is usually much more accurate than many other factors determined in the examination. The most doubtful question is likely to be whether or not sorting and selective mining may make it possible to improve on results obtained by former operators. In many instances this change has transformed an operating loss into a good profit. A study of stope assays, where these have been systematically recorded, often throws much light on this question. Sometimes special sampling, supplemented by experiments in sorting, must be resorted to. Selective mining will nearly always be met by violent opposition on the part of foremen and superintendents, who have been trained to regard per-ton costs, and not costs per unit of metal, as the measure of efficiency.

Features That Determine Operating Detail

In larger orebodies the influence of mining methods on the result of the examination is more likely to be decisive. The rate of production often determines success or failure. If a large tonnage can be mined daily, the resulting reduction of the overhead expense per ton may more than atone for the low grade of the ore. The adjustment of the overhead expense to size of orebody; the selection of open-cut, caving, or other plan of mining; the amount of dilution that will result; the cost of preliminary development and the amount of capital required for this development; the question of selective mining versus bulk mining—all of these problems must be decided before the future of a large low-grade mine can be judged.

Without a thorough knowledge of size and grade of the deposit, the geological conditions, and the physical character of the ore, an intelligent study of mining methods is impossible. Some of the worst mistakes in the history of mining have resulted from accepting false premises on these points. Several huge gold-mining enterprises have foundered because of the assumption that bulk mining on a great scale would yield the same grade as the smaller stopes of former operations. Failure to foresee the effect of a well-known fault on a caving system has cost millions of dollars. The selection of open-pit mining where the orebody was better suited to underground mining nearly wrecked a great corporation, and an underestimate of the cost of drilling and breaking an ore postponed the success of another for at least a score of years, after several millions had been spent in equipment.

Seldom can large-scale experiments in mining be carried on during the examination. The engineer must exhaust every line of attack in learning all the facts about the orebody, and then after planning various systems of mining in detail, must make the best guess he can as to the probable results of the system chosen. If these results agree fairly well with those at operating mines of similar character, he can be sure he has made no great mistake.

Unless enough ore is developed to be typical, a study of the probable method of treatment of the ore is not worth while. If a considerable tonnage has been developed, or if new ore is likely to be like that already developed, metallurgical study becomes a vital part of the examination.

Value of Former Metallurgical Records

If there has been a mill on the property, or if ore has been shipped to a custom mill or smelter, the problem is simple. A study of records will give a definite figure to start from. The old results may be improved on by a change in the shipping product brought about by selective mining or a change in character of ore in depth. The treatment in use may obviously be out of date or poorly adapted to the ore. But if actual results of past operations are known, there is a sure foundation on which improvements may be built. Elimination of any uncertainty should make the engineer happy.

If there have been no past operations to help in a study of ore treatment, this subject must be approached warily. It must be preceded by sufficient sampling to give a fair idea of the average quality and of the quantity of ore available. Then the cost of metallurgical tests must be in proportion to the size of the mine. If the orebody is small, it cannot bear the expense of elaborate experiments. The choice will then lie between shipping to a custom plant and putting up a simple mill, using a well-known process. Estimates of cost of treatment by the custom plant, or estimates of cost of construction and operation by some metallurgical laboratory which makes tests cheaply, must be accepted, subject to the general information of the engineer. If there is tonnage enough to justify greater expense, more difficult problems may be attacked. Then, in addition to asking the regular metallurgical laboratories to make suggestions, it often pays to employ independent metallurgists for the job, and to build small test plants. Such proceedings of course require a long option, or a price so low that it pays to buy a property on the chance that eventually the ore may be successfully treated.

It is a tribute to the metallurgists of today that if there exists a large tonnage of ore with a reasonable metal content, with practicable transportation facilities, it is usually assumed that a way will be found to treat the ore successfully. The experiments may be long and expensive, but finally the ore will yield to treatment.

Cost the Decisive Factor

If one link in a chain can be more important than the others, the most vital link in a mine examination is that of costs. The whole object of the work has been to find out whether a mine will make money. Yet the engineer seldom arrives at a point where careful consideration of this question is necessary. In most cases there is a factor so obviously weak that a detailed study of costs is unnecessary. A very rough approximation, based on experience with similar properties, will show that there is no chance of a successful outcome. Then

a more meticulous cost estimate would be foolish. Even in favorable reports, the best that can usually be said is that further development may find ore. Until this development is done, an estimate of costs or value is a pure guess. All that an engineer can do is to let his imagination loose, guided only by his experience, and paint a picture of the sort of mine he hopes to find. If this possible prize, in the event of success, is great enough to justify risking the money required for development, he can recommend the venture. In simpler terms, the pot is big enough to justify the ante.

If the method of treatment is not well established, an accurate cost estimate is, of course, impossible. Here the successful outcome depends on metallurgical instead of geological development. The chance of success in metallurgical development is usually better, and the justified outlay for purchase and experimentation is greater in proportion to the profit hoped for. But here too the engineer can only say that he thinks the prize is worth the risk.

Accurate Cost Data Depend on Well-Established Process

Once in a while an examination must be made of a mine in which a large tonnage of representative ore has been developed; in which future developments are likely to be commensurate with the price asked; and in which the probable method of treatment can be well established. Such a property gives the engineer a chance to use all his skill. He must sample and estimate the ore accurately, foretell the future by geological study, plan the method of mining and treatment, and finally make an estimate of the costs and value. Only after the first three stages of the examination are complete can the last one be attacked intelligently. Then the whole process of development, mining, and treatment must be followed through in detail, and a probable cost estimated for every step. The safe way is to make a cost sheet just like the one that will be used when the property is operating. If possible, an actual cost sheet of a similar mine should be used as a guide. By doing this, the chance of overlooking any step is minimized and estimated costs are checked against actual costs. In every item the probable error should be weighed, and a maximum and minimum figure set down, as well as the figure accepted as most likely. The total of these figures will show the probable degree of accuracy as well as the accepted estimate.

The last step is to calculate the present value of the property under consideration. With the costs, the rate of production, and the probable life determined, this is just a matter of applying the Hoover or Findlay formulas. The only new uncertainty is the rate of profit that should be expected—or the risk rate, as it is called by the Bureau of Internal Revenue. The engineer can either set a rate which in his opinion will make up for the degree of risk involved, owing to fluctuating metal prices or other doubtful features, or can set a low rate of 6 or 8 per cent, and tell his clients in some other way about what risk they will be compelled to run in the enterprise.

The examination has been a process of elimination, testing in turn the various points in the order of weakness as seen in the first few hours of work. The interests of the client have determined every step. He is entitled to the facts necessary for a correct decision arrived at with the least possible expense. As soon as there is sufficient evidence on which to base a definite recommendation, the examination is finished.

The Future of Cadmium

IN A PAPER on cadmium and its applications, read recently by M. Cournot before the Société des Ingénieurs Civils de France and abstracted in the Feb. 15, 1928, issue of the *Queensland Government Mining Journal,* the writer says that, although the discovery of the metal is more than a hundred years old, the industrial applications for the product are still very limited. The reason lies in the high price which ruled for so long. This unsatisfactory situation is, however, being changed, in the first place as a result of the development of electrolytic zinc production, which entails cadmium as a by-product; in the second place by the appearance of Australia in the world market, followed by a fall in the price, the wiping out of the German production, and successful competition with the American makers.

An increase in the use of cadmium is therefore to be looked for in the near future the writer thinks. This will lead to lower price levels as a result of further development of the means of production. After dealing with the metallurgy, the properties and employment of the metal, its salts and alloys, the note refers to the problem of cadmium coatings and to the experiments carried out by the writer and his colleagues on the subject. Electrolytic deposits of cadmium are characterized by their remarkable adhesiveness, even on aluminum and light alloys; their homogeneity, even in the hollow parts of the objects; their color, which approaches that of silver; their extraordinary resistance to corrosion, three times greater than that of zinc; their perfect behavior in water; and the absence of porosity, noticeable in the case of nickel plating. But coating with cadmium has two defects: it is soft, and its brilliance is speedily lost, not by corrosion, but owing to lack of hardness. The writer and his colleagues have succeeded in producing a coating which is invariable, hard, and brilliant, by superposing a nickel coating on the cadmium deposit. A large number of corrosion tests demonstrate the superiority of the cadmium-nickel coating to copper-nickel or zinc-nickel plating. It may be predicted that, in the near future, nickel plating will be invariably preceded by a light coating of cadmium to assure the impermeability necessary to afford a good resistance to corrosion. In conclusion, the writer considers that cadmium, although not a metal of wide consumption, like copper or nickel, should nevertheless succeed in attaining a not-inconsiderable position in the world market.

Accidents in Transvaal Gold Mines

ABOUT 20,000 whites and 186,000 natives are employed in the Transvaal gold mines. In 1926, the tons of ore milled amounted to 29,485,572 and production of gold was 9,666,901 oz. Fatalities in mining operations were 545 in the first eleven months of 1927, compared to 429 for the corresponding period of 1926. Estimates for both years are respectively 594 and 468. In each classification of fatal accidents except one, machinery, an increased number of fatalities occurred. The greatest cause of accidents, falls of ground, increased from 159 to 238 in the eleven months of record; explosives from 66 to 73; machinery decreased from 13 to 10; trucks and trams increased from 63 to 75; falling material from 27 to 34, and sundry or unclassified from 101 to 115. The fatality rate approximates 2.88 per year per 1,000 employed.

USEFUL OPERATING IDEAS

An Electrical Sounding Device for Boreholes

Presence of Salt Water May Also Be Determined by Apparatus —Likewise Temperatures

By Dr. Alfred Gradenwitz
Berlin-Friedenau, Germany

A RAPID and reliable means of ascertaining the often fluctuating liquid level in a borehole and the depth of the hole itself is of importance in driving wells. An electrical device for this purpose has been perfected by the Siemens-Schuckert Works, of Berlin. This device, shown on this page, comprises a winch *W* with a projecting beam *A* and an adjustable support *St*, a meter *M*, and a plummet *S*. The light but substantial winch is fitted with a hand-operated band-brake, enabling the speed at which the plummet is lowered into the borehole to be readily controlled. A ratchet keeps the winch at any height desired, even while the brake is out of action. The winch drum is designed for accommodating a cable 1,300 meters long and is driven without any gearing by two hand cranks, thus enabling the cable to be wound up rapidly. An electric signaling device consisting of a bell and a battery of two to five pocket lamp cells is fitted into the interior of the drum. One end of the measuring cable terminates in the drum, being connected up to the bell and battery, and the other end leads to a mercury contact in the plummet.

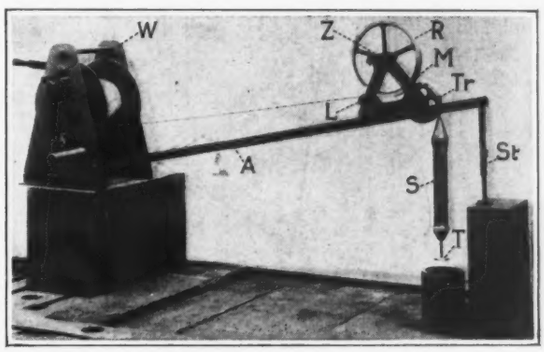
The beam *A* is so attached to the side walls of the winch that it can be folded up or removed for transport. Its length is such as to allow installation in any boring tower, the beam always being above the mouth of the hole.

The measuring cable is made up of three concentric strands: a carrying strand of several steel wires constituting the core, around which two insulated copper strands serving as conductors are wound. These three strands are covered by a substantial rubber sleeve, so that even prolonged immersion in oil will not harm the cable. The weight of 1,000 meters of cable is about 70 kg. The plummet weighs only 3 kg.

Meter *M* (see cut) consists of a standardized measuring wheel *R*, which is so connected with a counter *Z* as to have each notation of the wheel correspond to a length of 1 meter. Readings from this counter immediately indicate the actual depth of the plummet. The measuring cable runs over the guiding pulley *L* to the measuring wheel *R* and, over the carrying pulley *Tr*, away from it. Whenever the cable is lowered the counter is adding up; whenever it is lifted, the counter is subtracting. The measuring wheel and counter are so arranged that the former is carried along by the friction of the measuring cable, thus enabling even a possible expansion of the cable to be indicated by the measuring wheel.

The plummet *S*, shown suspended above the hole, is made up of a cylindrical brass sleeve of suitable shape, thus eliminating any risk of its being stopped accidentally by any rough or projecting parts. This sleeve comprises a brass frame, to which a cork float has been so fixed by means of two levers as to be readily moved upward and downward. An inclosed mercury contact has been fitted into the upper lever of the cork float, which in the upper position of the latter—that is on being immersed into the liquid—closes the circuit of the measuring cable and, in its lower position, interrupts this circuit. Inasmuch as a knowledge of the temperature of the liquid is desirable in connection with certain pumping processes, the plummet is fitted with a maximum and minimum thermometer.

The device can be used also to ascertain whether in addition to oil there is any salt water in the borehole,



Electrical device for ascertaining level of water or oil in borehole; also, the depth of the hole. The letters refer to the text.

and at what depth this is found. To make practicable measurements such as this, the plummet is fitted with two insulated copper electrodes connected up to the two conductors of the measuring cable. Although an immersion in oil, on account of its low conductivity, will fail to close the circuit between the two electrodes, a conductive connection will be made between them during an immersion in salt water. Inasmuch however, as the current would not be sufficient to operate the bell, a galvanoscope or milli-ammeter is used in this connection.

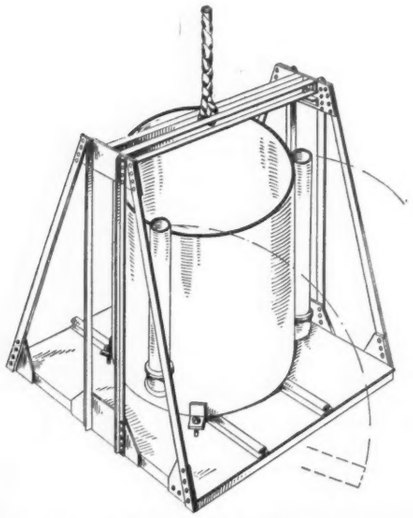
Lowering the plummet to a depth of, say, 500 meters (1,650 ft.) takes only from four to five minutes, during which time a change can hardly take place in the working level of the liquid. Though winding up of the cable takes somewhat longer, this does not in any way interfere with actual readings. Whenever the boring happens to be clogged by sand, the fact is ascertained by means of the electric sounding device, which then indicates the depth of a higher level and thus shows how many meters of mud must be removed from the boring. The new device is the outcome of comprehensive tests in various oil fields.

Emergency Bailing

By W. H. Hutton
Mexico City

BAILING WATER appeals to some mining men. In a sense it requires no "engineering." By a simple change it is quickly available in an emergency as a substitute or as an auxiliary to the more orthodox pumping plant. Contrary to belief sometimes held, it is by no means inefficient under suitable conditions. In a shaft subjected to seasonal flooding or the always possible stoppage of mine pumps, bailing skips provide a ready standby. When hoisting is by cage it is not even necessary to remove these, and they can remain as the "frame" of a cheap and simple bailing tank.

The perspective sketch shows a rig on these lines in use at a mine in Mexico. A pair of round (actually flat-sided oval to utilize full size of cage platform) tanks

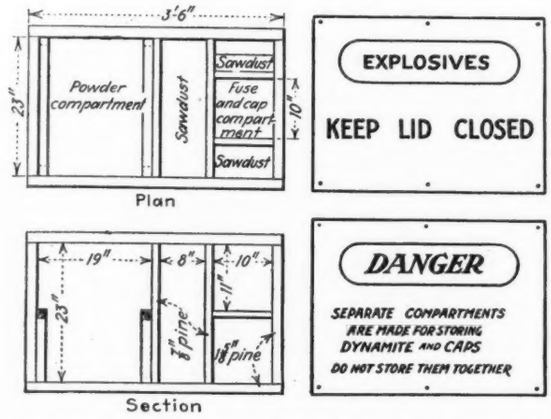


Bailing skip used in a Mexican mine

were built with a water capacity based on the power of the hoist. These tanks were clamped down over the rails, and, to insure access of free water to the bottom inlet valves, the cage deck was perforated immediately under the inlets. Further to eliminate discharge gear and catch aprons at the collar of the shaft, discharge was effected through a couple of standpipes which merely swivel on a slack thread and are pulled over by hand. These threw the water well clear of the shaft. Hooked to the top of the tank when in "shut-off" position the arrangement is wellnigh foolproof. The change from ore hoisting to water hoisting or vice versa can be effected in a few minutes' time.

Handling Explosives in Safety

THE accompanying drawing shows the plan and section of a powder, fuse, and cap box which appeared in the *National Safety News* for December. It was furnished by P. M. Archer, of the American Zinc Company of Tennessee, Mascot, Tenn. Where power is used to break large boulders and to start chutes that are choked, these boxes have been installed in the hope that the chute pullers will cease to handle powder carelessly. They have proved effective in preventing accidents, it is said. The boxes are placed near the chutes, but in a position



A safe powder, fuse, and cap box and its markings

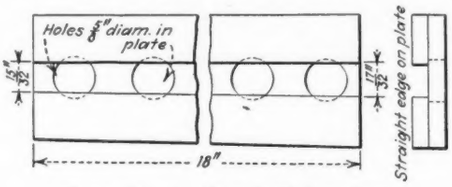
where flying rocks will not endanger them. Before installing the boxes, chute pullers were inclined to keep powder and caps together and in unsafe places; but since these boxes were devised, and strict rules put in force governing their use, danger has been eliminated. The two signs shown on the right of the illustration are fastened to the front and cover of the box.

Cleaning Quicksilver

THE ENGINEER of a large dredging company has found that the best and easiest way to keep quicksilver in good condition is to cover it with a thick layer of charcoal and retort it. This idea is not original, it is said, but possibly some amalgamators have not heard of it. The same company obtained good results by using granulated animal charcoal or coarse-grain wood charcoal. An ordinary water-jacket retort may be used, the water for the purpose of cooling and condensing the mercury vapor. A retort large enough to hold about three flasks of quicksilver is used. At another property the same company had a retort that held six flasks, with room for charcoal and expansion. Here a furnace was constructed from an old iron box and set into the hillside to conserve heat. At the first-mentioned property a furnace of brick was constructed. A rod is used to keep the outlet pipe open. Often this is accomplished by tapping the pipe with a hammer. A rod is used on the amalgam retort pipe also.

Gage for Ball Bearings

SOMETIMES it is necessary to check the size of ball bearings. A gage made according to the sketch has proven satisfactory for ½-in. balls. Roll the ball bearings between straight edges, starting from the small



Gage for testing ball bearings

end, until they fall through the holes in the plate. By checking the size of the balls falling through each hole it is easy to separate all sizes of balls in a short time. This check can be made as accurate as is necessary for any job.

DISCUSSION

Cornish Mining, Geophysics, and Psychics

THE EDITOR:

Sir—In Cornwall, within an area of about 1,600 square miles, roughly 5,000 lode mines have been worked in the last two centuries, and as many again might be worked in the future.

Almost every known mineral, metallic or non-metallic, has been found in Cornwall, including the rarest. Fewer than a dozen substances, however, have as yet been exploited, tin and copper predominating. From time immemorial up to about half a century ago, alluvial tin deposits were worked on a large scale; and during the middle period of the two centuries of lode mining of which I speak, Cornwall, for more than 50 years, was the world's largest copper producer. Alluvial tin and copper ores have been exhausted, but lode tin, in all likelihood, never will be; tin persists to a great depth, and there are so many occurrences of it, both in number and type. Apart from deep mines many tin-bearing lodes are already known, but still largely virgin, which at a lower figure than today's price for the metal would prove profitable. Because of past difficulties of tenure and recurring periods of low prices, these properties have been barely "scratched"; they have been merely proved to contain high tin ore over good widths and at shallow depths.

Many silver-lead lodes which are high in silver are unworked by reason of national impotence and inertia, difficulties of tenure in some few cases, and, until recently, recurring seasons of low price, as in the case of tin. Before lead fell to under £10 per ton about 35 years ago, there was a large production of these ores. There are a lesser but, in the aggregate, respectable number of small but extraordinarily rich silver lodes—a fact known to few. Their produce, in centuries past, has averaged about 400 oz. per ton of crude ore, as mined. None is working at present; for the exploitation of these and other ores containing the rarer and even rarest elements, from radium downward, it is impossible, in this poor old England of the present day to obtain capital or support.

For high-grade lodes of good size showing silver, lead, uranium, nickel, and other substances plus rich silver occurrences almost at grassroots—orebodies disclosed by surface pits and adit tunnels—capital cannot be found. Financiers and the investing public will tell you that these ores do not "exist" in Cornwall. Proof that they do exist, and documentary evidence showing the great profits recovered from the exploitation of some of them by our more enterprising and alert forefathers, appear to have no influence.

Now, only a part of the foregoing leads up to what I set out to say. This was that, taking into account Cornwall's record in metal mining and the fact that probably some hundreds of her mines were discovered by the divining rod (the lodes, here, seldom outcrop), I have been following, with impatient interest, the childish attempts of some correspondents of your esteemed journal, to throw ridicule upon divining—to dismiss the matter with some cheap sneer, or with an imputation of fraud concerning those who practise it. Heaven knows, many of these have been fraudulent; but so, likewise, have been many practitioners of the art of medicine: because, however, of these same black sheep is that art to be thought of as non-existent?

No, Sir: The divining rod has been and is a living reality in the hands of those (I am not one of them) so gifted; and for the first time in your journal I take note of a correspondent, Mr. Greenawalt, in your issue of Jan. 14, who hits the nail on the head. He has himself seen—and has been able to sift the grain from the chaff in this matter—that the real art exists, despite much charlatanism. He attributes it, as I myself do, to the correct source or sources: to those fully-demonstrated but as yet inexplicable psychic phenomena of which he writes; operative through many of us; unbelievable by the majority.

That we may in some future day possess knowledge of what this strange force consists is not impossible. At the beginning of this century how many of us would have believed in today's miracles of wireless—in television, for instance? Aye, says the sceptic, but all this is at least explainable upon scientific lines. Quite so, but these same or similar scientific data, in the mere nature of things, must be also available when the now-present mystery of psychic phenomena is itself solved; it will then become "scientific"—"mysterious" no more!

I thank Mr. Greenawalt for his most interesting, and—to me—convincing letter. To those who still choose to doubt and, well:

"There are more things in heaven and earth, Horatio,

"Than are dreamt of in your philosophy."

A. SPENCER CRAGOE.

Liskeard, Cornwall.

Tungsten Properties

THE EDITOR:

Sir—In the March 3, 1928, issue of *Engineering and Mining Journal,* you published a list of companies operating tungsten and molybdenum properties, and ask for the addresses of other companies not included in your published list.

I have a tungsten property in the Gold Range mining district, 12 miles east of Mina, Nev., which was developed in 1915 and a concentrating mill built. This property is now under lease to Alex Ranson and Frank Carlstrom, of Reno, who recently shipped a carload of concentrate. Please list this property: Wagner Tungsten Mine—Edward Wagner, owner, Main at 20th St., Wheeling, W. Va.

EDWARD WAGNER.

Wheeling, W. Va.

THE EDITOR:

Sir—I desire to add the name of a tungsten property to the list published in your issue of March 3, 1928.

Beeker, McLean, and Sullivan, Fruitland, Wash., are owners of the old Germania tungsten mine, in Stevens County, Wash. This property was controlled by German interests before the war and produced a considerable tonnage of 60 per cent wolframite concentrate that was shipped to Germany. We have recently secured control of the property and expect to get into production sometime this year.

BEEKER, MCLEAN, AND SULLIVAN,
by Henry Beeker.

Fruitland, Wash.

* * *

The Force of Example

THE EDITOR:

Sir—I thank Mr. F. L. Sizer for his timely comment on my letter. It gives complete expression to the thoughts I tried to convey. I too know Mr. E. P. Mathewson, and any university securing the services of a distinguished man like him is to be cangratulated. Mr. Mathewson, in giving his services to the University of Arizona, is in no small way altruistic. He, and many others of like ability and character, serve for the love of serving, and I agree that the industries that have created them should not be, because of this connection, entirely divorced from their valuable counsel.

A student in any mining school needs a stimulus and an incentive and objec-

tive, and he does not get these in engineering books, or by seeing his professor usurping the work which, ostensibly, he is being trained to do. In my opinion, every student in embryo at times wonders what it is all about. I did, and I know much of my stimulus came from reading biographies, such as that of the late Philip Argall, by T. A. Rickard in the *Mining and Scientific Press,* and others by Mr. Rickard, especially a biography of Richard Pearce appearing in a recent issue of the *Engineering and Mining Journal.* Biographies such as these give an incentive and stimulus to any student, and a man like E. P. Mathewson, if it were possible to have one in every mining college, would give the students an objective.

An objective and future is chosen, many times, solely for the money it might offer. This is the wrong attitude, as anyone will be convinced after reading the obituary of D. W. Brunton by T. A. Rickard. Napoleon stimulated his incentive by reading "Plutarch's Lives." I suggest a compilation of biographies of mining engineers by T. A. Rickard, and calling it "Rickard's Lives," thus giving young engineers a mark at which to shoot. I shall always remember the kind consideration, guidance, and long talks given me by the late Philip Argall at a time when I was in need of such a stimulus with which to attack the future.

J. P. RUTH, JR.

Denver, Colo.

* * *

Co-operation Needed in First-Aid and Mine Rescue Meet at Butte

THE EDITOR:

Sir—This year the Annual International First-Aid and Mine Rescue Meet is to be held at Butte, Mont., Aug. 20-22. For most teams the trip will be expensive because of the distance, but everyone is agreed that effective first aid is based upon keeping the idea constantly in front of both the individual workman and the pubic. Various means are used in different organizations to accomplish this maintenance of interest, and most companies hold this annual trip as a reward for effort, an educational device and a goal for the men in their employ to work toward.

Butte, during recent years, has spent several millions of dollars in ventilation, mine rescue, and first-aid work. The most effective and up-to-date equipment is employed here on a large scale, and both organization and devices are highly developed. For the visiting mine rescue and first-aid teams, many special inspection trips to mines, mills, and smelters are planned. Especial attention will be paid to the visiting of mines, so that those interested may personally examine and inspect fans and ventilation equipment; ambulance service; rescue stations and apparatus; safety devices; underground safety stations, and helmet equipment. They can see how fire areas are handled, and many other interesting and instructive matters of importance to the miner, the safety engineer, and the mine official. In other words, anyone coming to the Butte meet will not only be accorded the privilege, but will be urged to avail himself of the opportunity, of seeing in operation under almost all conditions any of the devices in which he is particularly interested.

We feel that the mine manager sending his men to Butte will get far more for his money than any similar trip in the United States, and that a great deal of benefit will accrue. Besides this, of course, will be the usual Butte hospitality, and we assure you the sky will be the limit. All roads will issue tickets at a fare and one-third for the round trip, and a side trip to Yellowstone Park may be arranged.

We believe that because of these decided advantages, many companies which heretofore have never entered teams in this meet, can well afford to consider Butte this year.

O. A. DINGMAN,
Montana State School of Mines.
Butte, Mont.

Consultation

Reconstructed Oils and Thiocarbanilide in Flotation

"What is the meaning, in flotation literature, of 'reconstructed oils' such as thiocarbanilide, for instance?"

Thiocarbanilide is not a reconstructed oil but an organic compound. It may be expressed technically as diphenyl-thiourea and is of the following chemical composition, $CS(NHC_6H_5)_2$. This compound is prepared by heating aniline with carbon disulphide, and is largely used in the rubber industry as an accelerator.

The term "reconstructed oils," as commonly used, applies to oils that have been sulphurized in some manner. Pine oil is commonly "reconstructed" by boiling with sulphur. The common procedure, in the laboratory, is to add a quantity of free sulphur, sufficient to assure saturation, to a flask containing pine oil. This mixture is then heated to boiling, and the resulting vapors are passed through a condensation tube. This is virtually a redistillation with sulphur. The condensed product contains sulphur in solution and yields a strong, offensive sulphur odor. Oils of this nature, generally speaking, have slightly weaker frothing qualities than the original oil from which they were distilled. Reconstructed oils are favored for ores containing oxidized minerals, as they seem to have some sulphidizing qualities, and thus higher recoveries frequently result from their use.

* * *

The Action of Diatomite With Concrete

"What is the action of diatomaceous earth when added to concrete?"

An extremely small proportion of diatomite has been found effective in preserving the uniformity of the sand and rock distribution in the mix. Concrete with such an addition retains its physical character until placed, even if delivered by launder or chute. Less water is required than is ordinarily necessary to insure satisfactory flow, and ultimate strength is thereby enhanced. If the mixture is being delivered by air pressure, or by means of a "gun," the improvement resulting is particularly marked. The diatomite doubtless aids in the transmission of jars and movements that assist even packing.

The addition of a finely divided silica to a concrete mix is by no means new. Information published more than a quarter of a century ago seemed to show that improvement in the quality of the concrete resulted; voids are thereby lessened in magnitude and greater bonding effect is secured. Tests have shown that the addition of clay may improve concrete; and lime has been used also to insure what is known as workability. Recent results, however, indicate that diatomite, per unit of weight, gives results that are superior to those obtainable by the use of clay or finely divided crystalline silica. Diatomite is a form of opaline silica—a colloid in gel form. Evidence seems to indicate that, apart from its action as a colloid, the addition of diatomite to a concrete mix results in an increase in the amount of normal bonding crystal structure.

* * *

Substitute for Gold

"Can you give me some information as to the composition of the 'gold' stars to be used in the place of numerals on the clock face in the Engineers' Memorial Tower at Louvain, Belgium?"

The stars for the Memorial clock referred to will be made of aluminum bronze of a composition as follows: Copper, 92 per cent; aluminum, 8 per cent. This alloy is ductile, has a high strength and high resistance to corrosion, may be easily worked and formed, and resembles gold closely in color. The American Brass Company was requested to supply the most suitable alloy for this work, and its 8 per cent aluminum bronze was selected for the reasons given above.

INDUSTRIAL PROGRESS

New Apparatus Devised for Breaking Up and Mixing Flotation Concentrate

A MIXING and disintegrating apparatus designed primarily for breaking up clayey materials, such as flotation concentrates, and mixing them with coarse concentrates, crushed ore, or similar materials, without clogging the apparatus, has been patented (U. S. Patent No. 1,649,939, Nov. 22, 1927) by F. M. Wichman and A. P. Hartlapp, of Salt Lake City, and the patent assigned to the U. S. Smelting, Refining & Mining Company.

The principal feature is the provision of a table or hearth, in combination with a series of plows and cutting disks to which the material is alternately presented upon relative rotation between the table and the plows and disks. The disks are similar in form to the well-known types of harrow disks and serve to cut or break up the material which is presented to them. The plows, which are similar to the usual forms of plowshares, serve to stir and turn over the material and also to deflect it toward the periphery of the table, where it may be conveniently collected. In the preferred form of the invention, the material is fed to the center of the table and is alternately presented to successive disks and plows for breaking up and mixing, respectively, the successive plows being arranged at increasing radial distances from the center of the table.

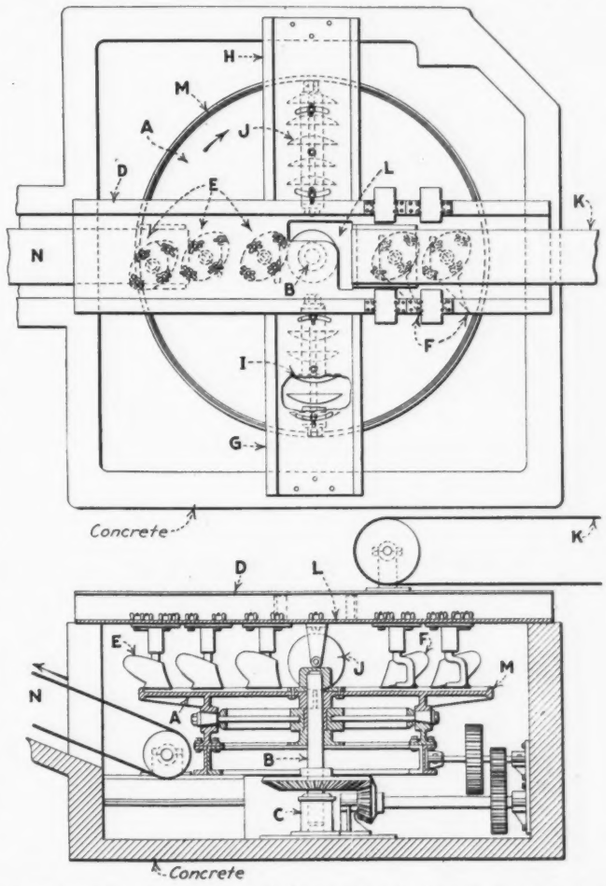
Other features consist in certain novel characteristics of construction and combination and arrangement of parts to be described.

Referring to the drawing, the apparatus comprises a table, or hearth, *A*, mounted on a vertical shaft, *B*, and supported upon suitable roller bearings, the shaft being journaled in an end-thrust bearing, *C*, and driven through bevel gears and suitable spur gears from any desired source of power. The table is inclosed within a concrete foundation. Mounted on this is a plow support, *D*, extending diametrically above the table. Two sets of plows, *E* and *F*, arranged radially of the table, depend from the support so that their points are slightly above and out of engagement with the table surface. The radial spacing of the plows of the set *F* from the center of the table is intermediate to the spacing of the plows, *E*. A pair of cutting-disk supports, *G* and *H*, is supported on the foundation and connected at their inner ends to the support *D*, being arranged substantially at right angles to the latter. The supports *G* and *H* each carry a gang of cutting disks, *I* and *J*, similar to the ordinary forms of harrow disks and mounted so that their lower cutting edges are raised slightly above the surface of the table.

The individual plows are mounted to permit angular adjustment with respect to the table. Provision for angular adjustment of the cutting disks is also made.

Material to be mixed is fed on a belt conveyor, *K*, through an opening, *L*, in the support *D*, to the center of the table. After continued operation the table is provided with a practically permanent bed of material, as a result of the fact that the plows and disks do not engage directly with the table. The table has a rim, *M*, upstanding therefrom a level approximating the lowermost position of the plows and disks to retain the bed of material on it. By this means, contact of plows and disks directly with the table is avoided, thus eliminating wear on the parts.

Upon rotation of the table, the material is first presented to the innermost cutting disk of the set *I*, by which lumps of the material are cut and broken up. Upon further rotation of the table the material is presented to the innermost plow of the set *E*, by which it is stirred and turned over and also deflected slightly toward the periphery of the table. The material is then engaged by the cutting disks of the next set and then by the first of the plows *F*, being again deflected further toward the periphery of the table, to be engaged by one of the intermediate disks of the set *I*. In its progress about the table the material is thus acted upon at least five times by the plows, in each instance being turned and stirred thereby, and an equal number of times by the cutting disks, which serve to cut and disintegrate the material. The material is



Sketch, in plan and section, of apparatus for breaking up and mixing flotation concentrate

successively presented to the plows at increasing distances from the center of the table, so that the movement toward the periphery is effectively accomplished. The amount of deflection may be varied by adjusting the angular positions of the plows, and the degree to which the material is disintegrated may be varied by adjusting the angular positions of one or both of the sets of cutting disks. In some cases it is desirable to adjust the two sets of disks at different angles, so that one set may tend to break up the material into coarse lumps and the other set into finer lumps. Under certain conditions of operation a double disintegrating action is obtained by adjusting one set of disks in a direction opposite to the other set relatively to the direction of movement of the material, thus insuring thorough disintegration and complete mixing of the material.

The material is conveyed away from the periphery of the table after it is moved outwardly by means of a belt conveyor, *N*.

BULLETINS

GRINDING — Abbe Engineering Company, 30 Church St., New York. Bulletin No. 23. Pulverizing, grinding, and mixing machinery. Twelve pages.

TABLES — Joplin Supply Company, Joplin, Mo. The Joplin Supply Company Magazine for January prints an article on Plat-O concentrating tables by B. J. Roberts, of the Deister Machine Company.

MOTORS—Allis-Chalmers Manufacturing Company, Milwaukee. Bulletin 1143. Line-start induction motors. Four pages.

PUMPS — Beach-Russ Company, 50 Church St., New York. Bulletin 36. Rotary pumps. Four pages.

MOTORS—Lincoln Electric Company, Cleveland. Bulletin 200-B. "Link-Weld" motors. Twenty-eight pages.

MOTORS—General Electric Company, Schenectady. Bulletin GEA-137A. Synchronous motors, 20-225 hp., for mounting on compressor shafts.

MINE SAFETY — Mine Safety Appliances Company, Pittsburgh. Catalog No. 3, revised. "Everything for Mine and Industrial Safety." Comprises 135 pages.

A Modern Way of Breaking Ground

IN THE Alaska Juneau mine, on Nov. 26, 1926, a powder drift blast using 21,000 lb. of powder was responsible for the caving of 3,000,000 tons of ore, writes J. A. Williams, chief engineer of the Alaska Juneau Gold Mining Company, in a recent issue of the *Du Pont Magazine*. The method of mining used consists in cutting out, 7 ft. high, an area about 300 by 200 ft. in dimensions with the necessary draw holes in it, and at the same time driving in the ground to be caved five or six stope raises to the level above. Then, when the undercutting is completed, the back of the stope is blasted down by means of large charges of powder placed in powder drifts driven radially from the stope raises. These drifts are 4 by 3 ft. in section and vary from 30 to 60 ft. in length; the burden on them is generally about 35 ft., depending on the nature of the ground and the size of the open stope below. After a stope has started to produce, no one enters it. Powder drifts are driven and blasted as needed, and the rock is drawn out at the bottom, where secondary breaking takes place in bulldozing chambers.

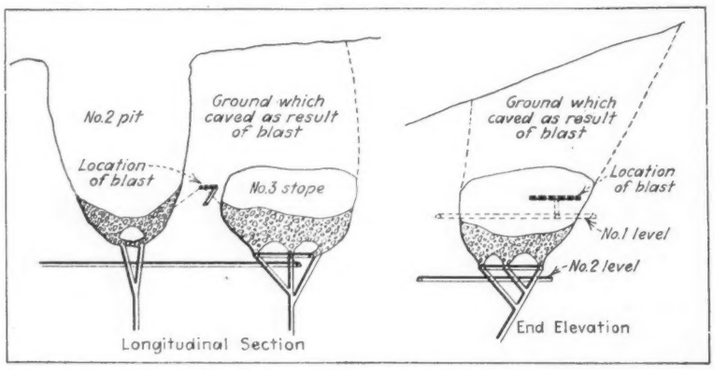


Fig. 1—Longitudinal and end views of orebody before the blast

In the south half of the mine, where the ore is usually not over 500 ft. deep, it is customary to bring the stope through to the surface as quickly as possible and then blast in the walls of the open pit with powder drifts.

The large blast mentioned took place in the south half of the mine (see Fig. 1), in the middle of a pillar 80 ft. wide and 200 ft. long, which separated No. 2 open pit from No. 3 stope and gave supports to it at one end. In spite of the occurrence of a fault along the boundary and the great area of the stope, 320 by 350 ft., no large amount of natural caving took place, owing to the strength and toughness of formations in which the ore occurs. Prior to the pillar blast 1,150,000 tons of rock had been broken by 25 blasts, using 167,700 lb. of powder in drifts driven a total length of 2,060 ft. These operations, it is claimed, contributed greatly to the final result when the pillar was destroyed.

For the final blast a powder drift (see Fig. 2) was driven 65 ft. each way from the top of a raise 40 ft. above No. 1 level, south. The powder drifts were driven about parallel with the axis of the pillar, so that the burden averaged 40 ft. Six separate charges of powder containing an average of 3,500 lb. of 40 per cent du Pont Red Cross Extra dynamite were used; one charge was placed in each face; the others occupied 10-ft. spurs spaced equidistant along the drifts.

The dynamite, in 1¼-in. by 8-in. cartridges, was trammed to the bottom of the raise, where it was transferred to canvas sacks and hoisted to the top. It was then dragged into the powder drifts and the cartridges were packed tightly against the solid rock. The charges were connected in duplicate by double-countered Cordeau fuse and then carefully tamped for about 15 ft. with fine rock stemming. The Cordeau was detonated by No. 8 blasting caps and two 30-ft. lengths of single-tape safety fuse.

Immediately after the blast, which took place after the shift had gone home, certain doors were closed to prevent the gases from penetrating the rest of the mine where operations continued. The ventilation system worked so successfully that the doors were opened with safety within eight hours after the shot was set off.

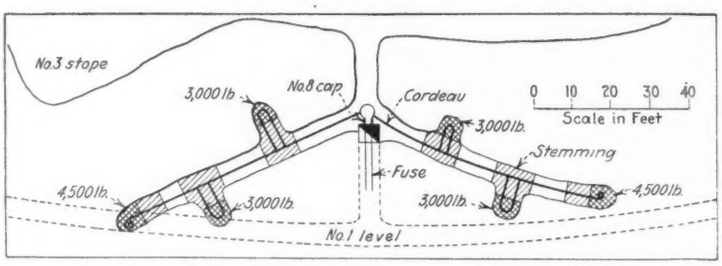


Fig. 2—How the charges were placed for the final blast which broke 250,000 tons of ore and caused the caving of 3,000,000 tons

The blast actually broke out 250,000 tons. This proved to be the key holding more than 3,000,000 tons, which subsided within a few hours.

For the total production from No. 3 stope the powder consumption for primary breaking will be less than .045 lb. of powder per ton of ore broken. The secondary breaking, it is estimated, will probably not require more than 0.22 lb. per ton of ore, which is the average for the Alaska Juneau mine.

NEWS OF THE WEEK

Summary

KATHERINE Gold mine, east of Kingman, was the first of the Arizona mining camps visited by E. H. Robie in his recent trip through the West. Developments in mining and milling at this interesting property are detailed on page 552.

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Ore reserves at the Waite-Montgomery property, in Rouyn, are put at 455,000 tons by the Quebec Bureau of Mines. Sudbury, Red Lake, The Pas, and Porcupine districts are all active with the approach of the spring season, permitting more extensive operations.

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Gross negligence on the part of Hollinger management and executives is the finding of the coroner's jury in investigating the recent disaster.

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Soviet Gold Trust is buying large quantities of dredging equipment and other machinery for shipment to Russia.

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New machinery, increased efficiency, and electric power are cutting down the labor costs at Michigan mines.

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Alma, Colo., is the scene of renewed activity. Several new plants have been built and old properties reopened.

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One man is rescued alive at Aurora mine, after being trapped by fire in an abandoned shaft for 16 days. Twenty-six lives were lost.

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Engineering committee draws up plans for World Congress to be held in Japan.

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Kernite deposit in Kramer district opened up by Pacific Coast Borax is probably most important commercial source of borax in the world.

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Fire at Granby Consolidated's Allenby mine was probably incendiary in origin, investigation discloses.

Lord, in Letter to Oddie, Explains His Stand on War Minerals Relief

By Paul Wooton
Special Washington Correspondent

SENATOR ODDIE, chairman of the Senate Committee on Mines and Mining, is in receipt of the following letter from Herbert M. Lord, Director of the Budget:

"I have your letter of March 3, 1928, regarding the bill, S. 1247, to amend the Act of March 2, 1919, providing relief in cases of contracts connected with the prosecution of the World War, otherwise known as the War Minerals Relief Act.

"The proposed legislation would affect the President's financial program, since it would, I am advised, reopen claims already finally settled under the law, and probably result in an additional expenditure of several millions of dollars from the Federal Treasury. The Secretary of the Interior presented an adverse report on the bill, and the President accepted the Secretary's and my own recommendation that the proposed legislation should be considered by him as in conflict with his financial program."

Representative Sproul, of Kansas, has announced, pending the completion of his minority report, that he is opposed to the War Minerals Act because it unduly favors the mining interests over the agricultural and other interests that undertook just as much during the war and lost just as much during the period of deflation.

Further Research in Geophysical Methods

Experiments with some of the electrical methods of prospecting have gone far enough to convince Bureau of Mines investigators that the existence of an orebody and a certain amount of valuable information as to its distribution can be obtained with equipment that is comparatively easy to procure by the practising mining engineer. These investigators, however, point out that the means of detecting the ore are not equally adaptable under all conditions. They also warn that the principles underlying geophysical prospecting methods must be applied judiciously, with a great amount of study and caution. Sound theoretical knowledge and extensive field experience are absolutely imperative, it is pointed out. Even then, it is admitted, the methods in their present stage of development are not altogether reliable.

The field work of the Bureau has been conducted, for the most part, on the northern slope of Caribou hill, six miles west of Nederland, Boulder County, Colo. The geology of the region is well known, and the hill has been the scene of mining operations since 1858. Other desirable conditions made the hill a desirable place at which to conduct experiments. Some work was done at Ward, 14 miles north of Nederland, where more readily oxidizable sulphides of iron and copper lie near the surface.

Experiments conducted in the Caribou mine tended to confirm that radio waves pass through rock but are largely weakened It is regarded as probable that these waves can be received at depths exceeding 500 ft. There is great need for establishing the fact that the air in the mine and the metallic circuits in the shaft have not acted as the conductors, it is stated, as that point has an important bearing on the studies of geophysical methods.

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Lookout Mountain Acquires a Mill for Its Ores

OFFICERS of Lookout Mountain Mining & Milling, which owns properties in the Coeur d'Alene district, Idaho, have announced the acquisition of the concentrator of the Amy-Matchless company, located near their own properties. The mill can treat 75 tons daily. It is said to be equipped with modern machinery, including jigs, tables, and flotation cells. It is a short distance from the Lookout tramway terminals and is easily accessible by truck haul. Some remodeling work will be done on the mill at once. New approaches will be made to permit the trucks to place the ore in the mill without necessitating additional handling, as at present.

Lincoln Mining, of Wallace, Idaho, has acquired three additional claims, which brings the total number of its claims up to 50. The claims recently bought were known as the Germain group, and they cut into the rest of the company's territory.

Machinery Cuts Down Labor in Michigan Copper District

INCREASE in efficiency, introduction of labor-saving machinery, and greater use of electric power have made it possible for three men to accomplish as much as five formerly were able to do, with the same producton, in the Michigan copper district. In addition to electric haulage, power shovels have taken the drudgery out of tramming and simplified the labor problem. Formerly, the mines depended largely on immigration, but immigration restriction brought about a change in tramming methods. Now native-born young men are attracted to the mines, receiving fair pay and a bonus on contract. In milling practice, regrinding of tailings has increased copper yield a pound or more per ton. Smelting also has been improved with introduction of large-capacity furnaces with automatic handling and casting devices.

Developments Recently Made at Calumet & Hecla

In the conglomerate department of Calumet & Hecla Consolidated, No. 4 Calumet below the 81 haulage level will be known as C shaft and No. 7 Hecla as A, below the 81. These are the only two shafts to be worked at that great depth. A is drifting on all levels below the 81, and on the 91 has reached a point 2,000 ft. north of the shaft. The opening will connect with the south drift from C. Intervening levels also will be connected, giving this part of the property long drifts, 8,000 ft. or more in length. In Nos. 6 and 7 shafts, Hecla, above the 81 level, pillar mining is proceeding, a considerable tonnage of rich rock coming from these operations. No. 6 is more advanced, mining of arches and pillars proceeding in several levels toward surface. In No. 7, arches and pillars were left intact in the three bottom levels as protection for the pumps. The 72 now is the deepest working level. An electric pump will be installed in No. 7 to replace air pumps now serving the south end.

At Quincy, the work of reconditioning No. 8 shaft, which has been idle for a number of years, will be started at once. Only minor repairs will be necessary. The hoisting plant is in good condition and the skips are ready to operate. No. 8 is well protected by thick shaft pillars and has not been affected by so-called "air blasts." Meanwhile, mining and opening work will continue in No. 6, where a new level has just been started, and repairs through the fire-damaged area in No. 2.

At Arcadian Consolidated, good progress is being made in deepening the New Baltic shaft. A new level has been cut 150 ft. below the 1,250 or present bottom level, and sinking will continue at least another 150 ft. before any drifting is done on the New Arcadian and New Baltic lodes.

In the Osceola lode department of Calumet & Hecla Consolidated, the four shafts in operation are yielding a good grade of rock. Osceola rock is being stamped in both the Calumet and Ahmeek mills.

Miner Rescued Alive After 16 Days in Aurora Mine

ACCORDING to cable dispatches received by the *New York Times,* Jose Ricardo, a miner, was rescued alive after having been entombed for 16 days in an abandoned shaft of the Aurora copper mine, in the village of Teziutlan, in which 26 of his companions perished of fire and poison gases. Ricardo was brought to the surface on March 25 by the rescue gang, which had been working day and night ever since the 27 were trapped. During the whole time of his entombment, Ricardo sustained life on water alone. He is now in a hospital, where his early recovery is expected.

The Mexican government is making an investigation of the cause of the fire in the Aurora mine, leased by the Mexican Corporation, a subsidiary of Santa Gertrudis. The damage of the fire is estimated to run into several hundreds of thousands of dollars. A number of commissions, composed of well-known mining engineers, have been appointed to examine conditions at some of the most important mining properties in operation in Mexico.

Coroner's Jury Emphasizes Negligence of Hollinger Executives

THE CORONER'S jury called for the purpose of inquiring into the death of 39 miners killed in the Hollinger mine disaster of Feb. 10 has returned the following verdict:

"We, the jury assembled, find that Lindsay, Kampula, Gardez (over whose bodies the inquest was held) and others came to their deaths between the morning of Friday, Feb. 10, and Monday, Feb. 13, 1928, at the Hollinger mine, from carbon monoxide poisoning due to the fire in stope 55 A.

"That fire was due to gross negligence on the part of the Hollinger management and the operating executives in allowing conditions to exist whereby their subordinates dumped large quantities of inflammable material in old stopes.

"We recommend that the old stopes where the rubbish has been dumped be cleaned out or made safe under the supervision of the government inspectors and that more mining inspectors be appointed."

The verdict of the jury appears to be a somewhat peculiar one in view of the fact that the government appointed a special commission to investigate the disaster, one of the chief duties of which would naturally be the fixing of responsibility. The sittings of the commission were adjourned during the coroner's inquest in view of the possibility that some new evidence might be forthcoming. No new evidence appears, however, and as far as the actual taking of evidence in connection with the disaster is concerned, this phase of the commission's activities has now been completed. At the coroner's inquest nine witnesses were called and much of the evidence submitted was similar to the testimony given before the Royal Commission. A. F. Brigham, general manager; John Knox, assistant general manager, and C. G. Williams, general superintendent, were all called and were asked if they accepted responsibility with the rest of the organization, which they did. The general practice of dumping refuse underground appears to have been approved by C. G. Williams and V. H. Emery, mine superintendent. However, the original practice consisted of diluting the refuse with large proportions of waste rock, which would of course practically eliminate fire hazard. The system had been accepted as part of the Hollinger method, and its abuse, which eventually led to the dumping of refuse directly into one of the old stopes, apparently grew because it did not appear to be the province of any responsible person to make it his particular business.

Before concluding the report the commissioner investigating the disaster will obtain the opinion of mine managers in the different camps regarding ventilation and similar matters. It is not expected that the commissioner will present a final report for some time, as the hearings of the commission took ten days and a great amount of evidence was given.

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New Iron-Ore Deposits Reported in Persia

The report of an expert employed by the Persian government to investigate the mineral resources of the country has disclosed the discovery of iron-ore deposits in Somman, said to be sufficient to meet Persia's needs for this metal for 20 years, together with beds of coal estimated to contain 30 years' supply, according to a report from U. S. Consul Orson N. Nielson, at Teheran, made public by the U. S. Department of Commerce. The report estimates that $12,000,000 will be required to establish blast furnaces, a steel mill, and an iron foundry on a large scale, but that a smaller unit could be established for $4,500,000. It is stated that the government is prepared to build this latter installation.

A group of men at the entrance to Kithil Tunnel

Old Properties Are Being Reopened and New Ones Developed in the Alma, Colo., District

DEVELOPMENT work now being done in the Alma mining district, Park County, Colo., bids fair to place this locality among the active producers of gold and silver bearing ores in the state. Minerals were first discovered in this district in 1859, when the Phillips lode was found. Present activity consists largely of reopening several of the old properties which had been abandoned and of exploring new territory, which, according to the reports of the U. S. Geological Survey, and to favorable geophysical tests, should be productive. The mineralized territory is about 20 miles long and 15 miles wide. The Colorado and Southern Railway connects it with the principal rail lines at Denver. The Public Service Company of Colorado furnishes ample electricity to the entire district. Timber and water for mining and milling purposes are available in large quantities.

One of the most important lode mines in the district is the property of London Gold Mines. It is situated on London Mountain, a spur of the Mosquito range lying between North and South Mosquito creeks. This property was discovered in 1873, and has been worked almost continuously since. It is credited with a total production of $7,000,000, the principal product being gold, with some silver and lead. The company is under the management of W. K. Jewett, one of the owners. Ore has been opened up about 500 ft. below the old workings. At present this stope is opened up for 600 ft. At the south end the vein averages 16 in. in width, but widens out to 5 ft. at the north end. The lower or main tunnel of the London mine is about 700 ft. below the south workings and is in more than 2,000 ft., but the ore has not been struck at this level yet. The company is mining 250 to 300 tons of gold ore a month, which is sent to the Arkansas Valley plant of American Smelting & Refining at Leadville, and to the Golden Cycle mill, at Colorado Springs, for reduction.

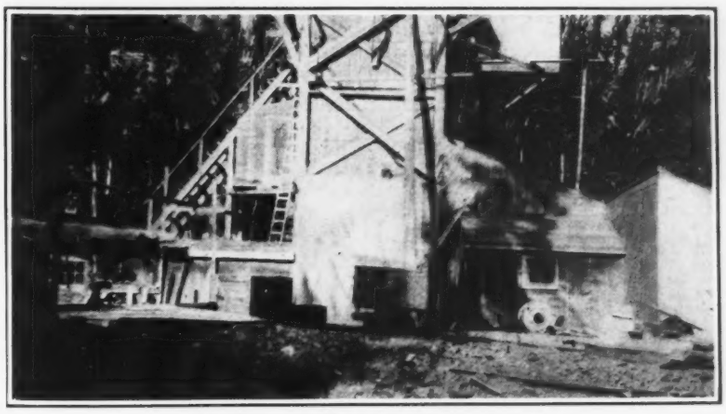
Bagdad Smelting & Refining has leased all of the workings and territory from the South London tunnel level to the top of London Mountain. In addition, the company has the rights to some property along the McDonald vein which contains some shipping ore. The ore is transported by aërial tramway from the portal of the Blanchard crosscut on London Mountain to the company mill in North Mosquito Gulch, where it is treated. The mill has a capacity of 60 tons. Treatment consists of flotation, amalgamation, and concentration. Concentrates are shipped to the American Smelting plant.

Work will be resumed at the Hock Hocking, a gold-silver-lead producer, as soon as the streams are free from ice, as power for the air compressor is furnished by a hydraulic plant. The property is situated in lower Mosquito Gulch. Orphan Boy and Mascot, two other properties in this section, are being reopened. An electrically driven air compressor and air drills are to be installed on the Mascot early in the spring. Orphan Boy already has a steam driven plant.

Mineral Park Mining purchased a group of claims on the south side of Mount Bross last year. That company has installed electric power and constructed new mine buildings and a 50-ton flotation mill. The ore is galena, carrying some silver.

Construction of the 60-ton cyanide mill of the Mount Bross Ores Company has been completed with the exception of the electric motors, which have not yet been installed. In the same section, Sweet Home Mining has driven its main tunnel a distance of 2,300 ft. and has cut and developed a number of veins.

Ford Mining & Milling is reopening the Hoil workings, situated on Mount Lincoln, which at one time produced silver. The company plans to mine and mill the low-grade ore left. Another silver producer on Mount Lincoln, the Russia mine, is being operated by Redman mines. This mine can claim the distinction of being one of the highest in the United States, elevation being 13,500 ft. above sea level.



New mill of Mineral Park Mining

Soviet Gold Trust Purchases $1,000,000 of American Machinery

AMERICAN dredge, drilling, mine and laboratory equipment valued at more than $1,000,000 is being shipped to the Soviet gold trust, Soyuz-Zoloto, by the Amtorg Trading Corporation, according to an announcement by Saul G. Bron, chairman of the Amtorg. American machinery will be used to increase the Russian gold production considerably beyond its present volume. In 1927 Soviet production of gold exceeded the 1926 output, valued at $21,000,000.

Among purchases made here was one of electrical equipment worth $100,000 for dredges being built in the Soviet Union. Several dredges have been also purchased abroad. The largest dredge in the world is at present being installed in Siberia by the Lena Goldfields Company, Ltd., which has a large concession in Russia. Other equipment for dredges obtained here is valued at $200,000. The remaining part of the purchases consists of equipment and supplies.

Revisiting Arizona Mining Camps

With E. H. Robie

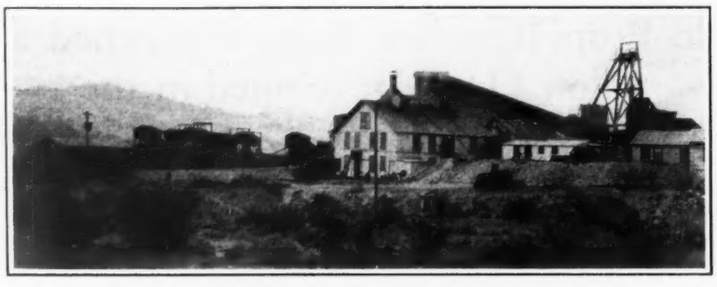
ARIZONA is not an easy place to reach from Salt Lake City, my immediate point of departure. The canyon of the Colorado River forms an effectual barrier against entering the settled portion of the state toward the west, and to the east no motor routes or railroads traverse the desert. So one must either take the Union Pacific, at least as far as Daggett, Calif., and thence proceed into Arizona by the Santa Fe, or else go into Colorado by the D.& R.G.W. and enter the state from the east. I chose the former route. By motor, one may branch off at Las Vegas, taking a shortcut to Needles, where the Colorado River is crossed, but no stage service is maintained. A stage runs from Barstow to Needles, remaining there overnight and then proceeding east to Winslow, Ariz., and beyond, but this parallels the railway.

From Tintic, Utah, to Barstow, Calif., and then to Kingman, Ariz., one traverses 800 miles of country without a mine of importance and apparently singularly free from mineralization. Kingman, however, the county seat of Mohave County, is the center of a region of some interest to the metal miner, so this was my first stop. There are no mines right at Kingman, but I found the Beale Hotel there convenient headquarters, and the mining men of the town did all that they could to make my visit to the district a pleasant one.

Of the present producing mines in this part of Arizona, that of the Katherine Gold Mines Company is easily the most important. This is 31 miles by road, a little north of west of Kingman, and is situated within a mile and a half of the Colorado River, in the locality known as Pyramid Canyon. This, I decided, would be my first objective. There is a stage line that leaves Kingman at 4 p.m. for Oatman, and at 5 p.m. for Chloride, neither particularly attractive for my purposes, but I found a Cadillac touring car available, at $15 per day, which solved my difficulty nicely. From Kingman to the Katherine is a trip of an hour and ten minutes, or was for me. Perhaps a driver more used to the thrills of narrow mountain roads, or less careful, would make it in less.

In the vicinity of the old Frisco property, in the Black Mountains, east of Katherine

The Katherine gold mine and mill, owned by the Sutro interests, of San Francisco, was described in some detail by Ray Dimmick, the manager, and Eugene Ireland, mill superintendent, in these columns a year ago (April 30, 1927). Present practice is substantially unchanged. As pointed out at that time, recent economies in grinding, in pulp handling, in chemical consumption, and in power generation have made this an exceptionally economical cyanide plant. The milling cost for 1927 was only $1.19, which for a two- or three-hundred-ton plant is exceptionally good. "We find it economy to buy the best of everything at a remote plant like this," said Mr. Dimmick. "Shutdowns and repairs are too troublesome." The best manganese-steel liners are used in the ball mills, with 5-in. forged chrome-steel balls. The two mills sometimes run for a full month without a stop. The "Superthickener" has been eminently satisfactory since the early difficulties were ironed out with the aid of the original designer, A. L. Blomfield. Incidentally, when Mr. Blomfield went back to Australia in February, to take up sheep raising, American metallurgists lost a popular and clever professional brother. Mill data for the year 1927 show that the filter-press tailing averaged only 9 mills per ton in gold and silver; the mill extraction was about 95 per cent. About 52 per cent of the pulp was ground to pass 200 mesh.



The Katherine mine and mill, near the Colorado River, northwest of Kingman

The power plant here is of particular interest, owing to the fact that extremely low costs are obtained and because three kinds of Diesel engines are in use. The power factor has risen recently to close to 0.9, with an accompanying slight reduction in power cost, which now amounts to about 1.7c. per kilowatt-hour. This is equivalent to a power cost, for mine and mill, of 40c. to 45c. per ton treated. Purchased power (Diesel generated) costs 3c. in the neighboring Oatman camp, I understand.

Two Fairbanks-Morse, one De la Vergne, and one Chicago Pneumatic of an old type are installed. The first named is here considered as the Ford of Diesel engines. It is simple, and spare parts are easily and quickly obtainable. The second type named is of more massive construction and has run for as long as four or five months without stopping. It was installed in 1921, and had its first overhauling last year. Its fuel economy is exceptionally good, giving about 11 kw.-hr. per gallon of oil. At present no spares are available to carry the load in case of emergency, so the purchase of an additional 1,125-hp. De la Vergne unit is being considered.

A Chicago Pneumatic compressor, 24x14 in., has given exceptionally good service at this plant. Installed in 1921, the only spare parts required in seven years of operation have been three sets of valve disks. Last year it was down only 28 hours in the entire year.

Underground, water flows out of the vein below the 350 level, the mine making about 275 gal. per minute. To handle this flow, two vertical centrifugal Byron Jackson pumps were installed last year. Each has a capacity of 300 gal. per minute, affording ample pump equipment as greater depths are reached. The shaft is now down 1,000 ft., giving six new levels. It is drained to the 600, which is now being opened up. In walking about the 300 level I noticed the method of putting head boards on the posts to prevent the latter from cutting into the stulls. The rock settles slightly along slippage planes after the drifts are timbered. The head boards, when badly crushed, are removed after jacking up the stulls, and new pieces put in their place, obviating all damage to the more expensive stull timbers. Mine timbers from Oregon cost $31 per thousand delivered, somewhat cheaper than awhile back. About 60,000 ft. are used per month.

Partaking of a substantial dinner at the boarding house I was again struck, as I have been before, with the speed at which a workman can swallow, if not chew, his food. Ten minutes seems to

be required by the man with an average oral opening, though I was assured by the waitress that not more than five minutes was par for the course, or courses as it was here, with soup and cherry pie.

Clustered about the successful mine are invariably numerous "extensions." The Katherine Extension and the Katherine Treasure Vault may be found searching for ore to the east. To the west, at the Colorado River, is the Empress group, controlled by the du Ponts, said to be down 200 ft. and getting lots of water—but also a nice showing of ore.

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Preliminary Plans for World Congress Are Formulated

ENGINEERING leaders from practically every portion of the United States met in Washington March 22, and formulated preliminary plans for the participation of American engineers in the World Engineering Congress which will be held next year in Tokio. An American committee to arrange for the part that the engineers of the United States will play in the congress was organized and officers were elected.

At a dinner given in honor of the American committee by the Japanese Ambassador at the Carlton Hotel, where the organization took place, Dr. Elmer A. Sperry, of Brooklyn, who was elected chairman of the Amercian committee, predicted that collaboration of engineers throughout the world will facilitate transactions and intercourse between different countries and greatly contribute to the general development of world industry. Dr. Sperry pointed out that human welfare is largely dependent upon the activity of engineers and scientists. The coming together of engineers and scientists, with the consequent comparing of data and experiences, Mr. Sperry said, will not only advance the world's engineering status and contribute to world prosperity, but will simplify production and minimize variations.

The Japanese Ambassador, Tsuneo Matsudaria, said that both Japan and the Engineering Society of Japan, under whose auspices the congress in Tokio will be held, were gratified at the acceptance of the American engineers to participate in the congress.

The following officers and committee chairman of the American committee, which will arrange for the sending of a large delegation of American engineers to the congress in Japan, were elected: Honorary chairman, Herbert Hoover; chairman, Elmer A. Sperry, New York; vice-chairman and chairman of the executive committee, John W. Lieb, New York; vice-chairman, C. E. Grunsky (Pacific Coast) San Francisco; C. E. Kettering (Middle West) Detroit; executive secretary, Maurice Holland; executive committee, Gano Dunn, George W. Fuller, W. E. Wickenden, Maurice Holland, Frank B. Jewett, John W. Lieb, Calvin W. Rice, and James H. McGraw, all of New York; Dugald C. Jackson, Cambridge, Mass.; O. C. Merrill, Washington, D. C.; Charles F. Scott, New Haven, Conn.; Elmer A. Sperry, Brooklyn, N. Y.; finance committee, John W. Lieb; technical program committee, D. C. Jackson; transportation committee; F. B. Jewett, entertainment committee; O. C. Merrill; publicity, James H. McGraw; promotion and attendance, George W. Fuller; nominating committee, Gano Dunn.

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California Kernite Deposit Most Important Source of Borax in the World

Low Cost Mining and Refining Anticipated—Production Now Totals About 380 Tons of Mineral per Day

NEW aspects in the present situation of the borax industry have been disclosed by an authority as the result of the recent development of important new deposits of borate minerals in the Kramer district in southeast Kern County, Calif.

The new mine that has been opened by the Pacific Coast Borax Company in the northeast corner of Sec. 24, T. 11 N., R. 8 W, and the extreme northwest corner of Sec. 19, of the township next adjoining on the east, is apparently now on regular production, with railroad connections established and shipping the new kernite ore in large quantities. The present output of borate ores or products in the United States is approximately as follows:

	Average Daily Shipment
Pacific Coast Borax Co. mine near Kramer, Calif.	200 tons crude kernite ore of high purity.
American Trona Corporation, Searles Lake, Calif.	140 tons refined borax.
West End Chemical Co. mine near Las Vegas, Nev.	25 tons calcined colemanite.
West End Chemical Co. plant at Searles Lake, Calif.	15 tons refined borax.
Total daily production	380 tons.

The total production represented by these averages, if they are maintained throughout this year, will be approximately 140,000 tons of borax for 1928, which is probably approximately the amount of present market requirements.

The new source of borate mineral at Kramer is probably the most available source of borax that the world has ever known, in quality of material, massiveness, purity, minability of the deposit, and accessibility. The new mineral kernite apparently exists under extremely favorable mining conditions, so that the ore can apparently be brought to the surface at a cost of less than $10 a ton. It may be recalled that the kernite ore recovered in such pure form as indicated by the present operations should yield more than its equivalent in weight of commercial borax, and that only the simplest refining processes are required to transform the crude material as mined into the commercial product. Therefore it is entirely likely that the cost of borax may be cut from recent quotations, which have ranged around four cents a pound, to one-half that amount or even less.

Another interesting factor may also have an important influence in the production situation and marketing of this product. It appears that an important extension of the richest part of these deposits lies south of the property now being operated, and this new deposit is evidently under independent control. The discovery was made by borings and is situated about three-quarters of a mile southwest of the original shaft in the northeast corner of Sec. 24. According to authentic information, these borax deposits revealed a thick section of particularly pure kernite in the new area referred to, and a mining shaft is being rapidly sunk to develop this new deposit. The material which may be developed from this independent operation promises to exert an important influence within the Kramer district.

Department of State Opposes Restriction of Immigration From Latin America

SECRETARY of State Kellogg, in opposing restriction of immigration from Mexico, informed the Senate Immigration Committee that American diplomats in Central and South America had been asked for reports by his department as to the effect of such action upon the relations between the United States and those countries. He said that the replies justified the statement that any attempt to restrict immigration would be resented in Latin America.

The Secretary quoted from letters from mining companies in South America in opposition to the proposed legislation. One of these was from the vice-president of a mining company operating in Chile, who stated that immigration restriction against the citizens of that country would result in a similar action by the Chilean government against the admission to Chile of managers, engineers, and trained workers from other countries. Protest was also made by the Chile-American Association, which includes the important American mining and industrial companies with large interests in Chile.

Another protest came from a company having a large investment in copper properties in Mexico, which said that if the United States restricted immigration from Mexico, that country would retaliate by interfering with the company in securing technical workers who have to be brought into Mexico. The president of a company employing 850 men in mines in Mexico opposed the restriction, as it would react unfavorably against American interests there.

Waite-Montgomery Reserves Put at 455,000 Tons

THE FIRST official statement of ore reserves on the Waite-Montgomery property in the Rouyn district, which is controlled by Noranda, has been made by the Director of the Quebec Bureau of Mines. He states that diamond drilling has indicated 455,000 tons of ore, averaging 2.4 per cent copper and 8.6 per cent zinc. Gross value is estimated at $16 a ton, giving a total value to the ore reserves of $7,280,000. It is understood that no shipments will be made from the property before July and that all ore will be treated in the concentrator being built by Noranda.

Jay Copper, which lies north of the Rouyn district, reports the discovery of a new orebody at a depth of 200 ft. Crosscutting has shown a zone approximately 45 ft. in width and 200 ft. north of the other known orebodies. The shaft is down to the 500 level. It has been decided to diamond drill the new zone from this point.

It is understood that the Argonaut and Amity properties in Ontario are negotiating with Noranda for the treatment of custom ores. Argonaut, which is at Larder Lake, at present is shipping copper-gold concentrates to the United States. Rail haul to the Horne smelter would make possible a large saving in transportation charges. Amity is opening up a copper deposit near Kirkland Lake and is prepared to ship a limited tonnage of raw ore.

Diamond-drill results at the Sudbury Basin mines, in the Sudbury district, have sent the quotations of the stock sky-high. The Sudbury Basin company is controlled by Bunker Hill & Sullivan. Its properties adjoin those of the Errington mines, also a Bunker Hill & Sullivan subsidiary. The ore carries values in gold, silver, lead, copper, and zinc, the last two being the more important. Directors of the company state that a study of the intersections recently drilled disclosed the fact that an orebody which outcropped on Sudbury Basin ground was dipping into territory not owned by the company. Negotiations are being made for the purchase of the property.

A delay of several months has been caused by the advance of the season in Howey Gold Mines' program for mill construction at its properties in the Red Lake district. The roads are no longer in condition for the transportation of heavy machinery, as the snow has begun to melt. During the summer it will be possible to transport some of the machinery by water, but the heavier parts will be delayed until next winter. In the meanwhile construction will be completed as far as possible.

Shaft No. 1 at Sherritt Gordon, in The Pas district of northern Manitoba, has reached a depth of 80 ft., permitting the erection of a large headframe. Shaft No. 2 is down 70 ft. When this reaches 80 ft. it is planned to sink a third shaft at some midway point, as the distance of the two main shafts makes good ventilation difficult. Six diamond drills are being used on the property, three of which are exploring the area beneath the lake.

An orebody has recently been discovered on the 2,000 level of the McIntyre Porcupine, in the Porcupine district of northern Ontario. It appears to be a continuation of the ore from the adjoining Hollinger mine. Crosscuts from the 3,375 and 3,875 levels of the new 4,100-ft. shaft are approaching the ore zone.

Continued underground exploration on the property of Harkness-Hays Gold Mining, two miles east of Schreiber, Ont., is reported to have had good results. The location of the property, directly beside the main line of the Canadian Pacific Railway, together with the unusual geological characteristics, has made for economical operations. The company has spent almost $100,000 in the development work, and consideration is now being given to the question of milling facilities.

Ontario Makes Fire Hazard Survey

A SURVEY of fire hazard in Ontario mines is now being carried out by the provincial government inspectors under Chief Inspector Thomas Sutherland. Every district will be thoroughly examined. Mr. Sutherland's assistants are A. G. McMillan, in charge of the Kirkland Lake and Cobalt areas; George E. Cole, in charge of Porcupine; and D. G. Sinclair, Sudbury.

J. E. Hammell's idea in forming the Northern Aërial Minerals Exploration is to use the airplane to send out prospecting parties into remote sections; for the transportation of men and supplies; and in order to keep engineers in touch with prospecting parties and with new developments. The company has a capitalization of 100,000 preferred shares of a par value of $50 and 250,000 common shares. Each preferred share carries a bonus of one share of common. Mr. Hammell gives his services for five years without any cash compensation, but for this is to receive 10,000 shares of preferred stock; 150,000 shares of common stock also goes to Mr. Hammell; and out of this he has to take care of Captain Oakes, the prospectors, and the key men of the organization. It is understood that the proposition has already met with a favorable response.

Geologist Thinks Wahmonie "Has a Chance"

In a recent statement in the *Nevada State Journal,* Letson Balliet, geologist and mining engineer, says of the reported discoveries at Wahmonie, Nevada's latest boom camp:

"Wahmonie has a chance. It has several good showings, that are improving with the work that is being done. It is a prospect that is encouraging. It is justified in encouraging the hopes that another city may come to life upon the desert, and be a producer of metallic ores in important quantities."

Fire at Copper Mountain Was Probably Incendiary

INVESTIGATIONS have disclosed that the fire at Granby Consolidated Mining Company's Copper Mountain mine, Allenby, B. C., which killed nine men on March 18, was probably of incendiary origin. The fire destroyed the new bunk house, causing damages placed at $30,000. It originated in a waste-paper basket on the ground floor of the bunk house at about 4:30 a.m. About 90 men were sleeping at the time, and most of them were forced to seek escape by jumping from the second- and third-story windows. In addition to the nine killed, about a dozen were seriously injured. The Kettle Valley Railway rushed a special train to the scene of the disaster, with doctors and medical supplies, and in it the more seriously injured were taken to Princeton hospital, 12 miles distant.

Belief that the fire was started deliberately has been strengthened by the fact that a fire was discovered in the waste-paper basket of the other company boarding house, which, fortunately, was extinguished before it did any damage. In 1925 the Granby company's boarding house at Allenby was burned just after it was finished and before it was occupied.

H. R. Plommer, secretary for the company, states that the building, which had accommodations for 110 men, was adequately served with 4-in. fire hydrants, each with 2½-in. nozzles and ample water pressure. On behalf of the company, he expressed deep regret over the tragedy.

James Dickson, chief inspector of mines for British Columbia, is in Copper Mountain conducting an investigation for the provincial department of mines.

Virginia Manganese Property to Be Reopened

Midvale Manganese Company, a Delaware corporation, has purchased the properties of the Rockbridge Manganese and Iron Company, in Rockbridge County, Va. During the war this property was developed and equipped with a large washer and mill, but the low and uncertain prices which have prevailed since caused its closing down. The present owners will overhaul the washer and mill and equip with the most modern machinery.

Receivers Put in Charge of Idaho Metals

Judge R. W. Adair of the district court of Idaho placed J. L. Bills and E. W. Hovey in charge of the properties of the Idaho Metals Company on March 20. The Idaho Metals mine is near Mackay, Idaho. It is said to be the largest copper mine in the state. The receivers have not announced any definite plans as yet, but did say that they would begin operations in the near future.

Mexico City Letter

By W. L. Vail
Special Correspondent

Mining in Northern Mexico Is Reported to Be Satisfactory

Mexico City, March 14, 1928.—General conditions of the mining industry throughout Chihuahua and the north are reported as fairly satisfactory. Cusi-Mexicana Mining, operating at Cusihuiriachic, in western Chihuahua, is intensifying its work. At the mine the company has just completed expansion of the mill capacity from 125 to 325 tons daily. Development work on the Santa Marina and San Antonio veins has shown new orebodies laterally. Shaft sinking from the old 1,040 level has been started. The shaft is being sunk on the footwall side of a chute of ore containing silver-lead-zinc values. This property was originally opened in 1666, and has produced more than 100,000,000 pesos, worth of minerals. It was abandoned for many years, but in 1925 unwatering of the Santa Marina and San Antonio veins was undertaken.

Reports from Sonora state that some new asbestos deposits have been discovered near Masiaca station, on the Southern Pacific railway, in the district of Alamo.

United Eastern Mining & Milling of Los Angeles, Calif., is conducting a series of experiments on some recently acquired old dumps in Guanajuato, under a secret process owned by John Allingham, by which it is said all the mercury can be recovered from the tailings, as well as the gold and silver content. The plant now being constructed at Guanajuato will have a capacity of 150 tons a day. If results are satisfactory it is proposed to increase the capacity to 600 tons daily. The plant is expected to be ready on May 1.

MORE THAN $500,000 in gold-silver bars is being sent to the A. S. & R. plant at Selby, Calif., monthly by the San Dimas mine, Durango; Tayorita property, Durango; and a number of properties in Sinaloa.

An unusual amount of interest is being taken in mercury properties throughout Mexico, due to the exceptional prices that are being received. The increase of production of mercury in 1927 was 78.6 per cent, the largest increase of any mineral. Many new denouncements of mercury properties are being made in Morelos, Guerrero, and Michoacan. Several small plants are being erected. Most of the Mexican deposits are superficial and short-lived, but as long as prices remain high there is sure to be some mercury production.

The Tajo mine at Rosario, State of Sinaloa, is being cleaned up, at present. It belongs to the Bradbury interests. Very little work is being done on the Bradbury properties in Jalisco and Zacatecas, largely due to local conditions, but some development work is being carried on.

The Federal Arbitration Board has finally rendered a decision in the case of the Piedra Bola mine, of the Amparo group, State of Jalisco, which requested permission to close operations some time ago, because of exhaustion of paying ores. The workmen opposed the appeal. The court decided (1) that the company was within its legal rights in closing; (2) the company was authorized to discharge all but 169 men, who will be kept on exploration work; (3) that employees retained should be according to time of service and record of work; (4) the company shall pay the men discharged from March 2 to 8, and (5) should the company renew operations preference will be given to the men who have been discharged. The management is satisfied with the decision, but the men have not yet been heard from. The Amparo and Mazeta continue to operate full time.

Johannesburg Letter

By John Watson
Special Correspondent

Transportation Over Land to Egypt Interests Johannesburg

Johannesburg, Feb. 21, 1928.—Interest in the possibility of an all-land route from the Cape of Good Hope to Egypt has recently been aroused in Johannesburg. Dr. Samuel Evans, chairman of the Crown Mines, Ltd., advocates a co-operative scheme embracing all the African governments, from the Union to Egypt, to establish a rail, air, and steamship route to England. The economic basis of success would be part of the trade now carried by ocean, particularly gold, which would be diverted to the quicker and safer overland route. A. Barnes, the explorer, recently crossed Central Africa, including the entire length of the new 770-mile railway from Lobito Bay to Luacano, on the Angola-Belgian Congo frontier. The new route will save 2,500 miles, enabling Central Africa to be reached directly from Lobito instead of through the Suez Canal.

Prospecting for platinum conducted by Transvaal Consolidated Land and Exploration gave encouraging results, according to a report of the company. The work has been done in the Rustenburg district. Sufficient preliminary work has been accomplished to obtain reliable samples of the ores. Operations have been suspended pending the result of extraction experiments.

MAID of De Kaap Gold Mine, near Barberton, has recently been sold by Thomas Andrews & Sons, Ltd., to the Bailey group of mines, at a price reported as £185,000. This is the largest mining deal in the Barberton district for many years.

London Letter

By W. A. Doman
Special Correspondent

Deutsche Bank Will Provide Funds for Development of Altai Concession

London, March 13, 1928.—On March 12 announcement was officially made that the Deutsche Bank was co-operating with the Lena Goldfields, and had arranged to provide the necessary funds for the development of some of the properties on the Altai Concession, including the equipment of the Zerianovsk mine. Also, funds are to be found for an increase of the iron and steel works in the Urals "in order to provide certain classes of manufactures which are much needed in Russia at the present time." Although the terms are officially described as "mutually satisfactory" shareholders do not appear to be any too pleased, as details are not given. They regard it as a case of always "jam tomorrow," but none today. The Lena company has produced large quantities of gold since the agreement with the Russian Government over two years ago, but none has yet reached the shareholders. Speculation in the shares has been most active during the last three weeks, at anything up to 10s. and over, and on the Paris Bourse the quotation is the equivalent of 20s. here.

The Nigerian Tin amalgamation scheme has reached a lively stage. At yesterday's meeting of shareholders of the Keffi, some of the members frankly criticized the proposals, and said it was not to their benefit to be taken over by the Associated Tin Mines of Nigeria. James Fairbairn, who presided, stated the case quite fairly, but he was unable to convince the meeting, and a poll had to be taken, which resulted in the acceptance of the scheme.

THAT TIN is still a metal to conjure money out of the hands of the public, however, is clear from the fact that new companies are making appeals. One of these, and it appears to be a good one, is the Tigon Mining & Finance Corporation. Strictly speaking, this company is not asking for capital, but is putting its shares on the market. It was formed as long ago as 1913, under the title of the Anatolia Copper Company, changing its name in 1926. It acquired a mining property known as Inglaterra No. 809, in the province of Zamora, Spain, with an area of over 1,820 acres, and also acquired options to purchase mining properties in Granada and Cordoba. The Inglaterra Concession contains at least two large tin-bearing lodes. The company has also acquired sulphur properties, and silver-lead antimony mines in Almeria, Spain. "A very rich lode of silver, lead, and antimony" has been found to exist over at least 300 meters in length with a width varying from 3½ to about 5 meters.

Personal Notes

E. J. DUGGAN, mill superintendent for Kennecott Copper Corporation in Alaska, is in New York on a short visit.

ARTHUR W. JENKS has returned to the United States from Colombia, where he has been engaged for the last four months.

SIR WILLIAM THOMSON, principal of the Witwatersrand University, retired on Feb. 29. He is succeeded by H. R. RAIKES.

T. J. JONES, who was at one time superintendent of the Iron Mountain mine, in Shasta County, Calif., revisited the mine recently.

CHARLES BUTTERS, of San Francisco, is examining old placer and mercury properties in the Guadalcazar district, San Luis Potosi, Mexico.

R. J. DUNCAN has been appointed superintendent of the Moore Mining Company's properties near Jackson, Amador County, Calif.

CHARLES SPEARMAN, consulting engineer of Montreal, is in charge of diamond drilling on the property of the Selkirk Mines in the central Manitoba mining field.

R. E. PALMER is the consulting engineer for Tigon Mining & Finance Corporation, which owns properties in Spain. JAMES HOCKING has been appointed manager.

EDMUND S. LEAVER, director of the Rare and Precious Metal Station of the U. S. Bureau of Mines at Reno, Nev., is visiting the Bureau of Mines station at Berkeley, Calif.

LOUIS DUSHARME, who has constructed many large mills in eastern Canada, has gone to northern Manitoba to install a mill on the Mandy property in The Pas district.

E. P. HENDERSON, of the U. S. Geological Survey, left Washington recently for Roswell, N. M., to join other members of the Survey in the investigations of potash deposits in Texas and New Mexico.

ADRIAN D. JOYCE, of Cleveland, Ohio, visited the properties of the California Zinc Company in Shasta County, Calif., recently. He is president of the Glidden Paint Company and controls the California Zinc Company.

E. G. JARVIS, president of the Niagara Falls Smelting & Refining Corporation and American Boron Products, has been elected chairman of the metal division of the National Association of Waste Material Dealers, Inc.

F. T. WHITWORTH, who has developed a number of the newer flotation reagents, plans a visit to mining areas in the Southwest on business for the American Cyanamid Company, with which he is now associated.

H. L. KRAUSE was elected president of the Association of Mine Managers of the Transvaal at the thirty-third annual meeting, held recently in Johannesburg. Mr. Krause suceeds M. O. TILLARD. B. ORPEN was elected vice-president.

A. H. MEANS has been put in charge of the mining and geological department recently established by the American Smelting & Refining Company at its Salt Lake office. Mr. Means has had a

A. H. MEANS

wide range of experience in South and Central America, British Columbia, the United States, and Newfoundland. Later in the year, A. E. RING, formerly manager of the Rawley mine at Bonanza, Colo., will join the department at Salt Lake.

RAYMOND G. TRAVIS, mining engineer, is spending some time in New York City. Mr. Travis recently returned from the Choco district of Colombia, where he was engaged in professional work for South American Gold & Platinum.

HOWARD I. YOUNG, general manager of the American Zinc Company, Mascot, Tenn., has been elected a director of the American Zinc, Lead & Smelting Company, which controls American Zinc, and has been made vice-president in charge of all operations.

A. N. BAKHTIAROV, chief engineer of the Soviet Southern Ore Trust, is now in the United States studying American methods of mining iron ore. Mr. Bakhtiarov is accompanied by three officials of the trust. They will visit the Alabama and Michigan fields.

E. H. ROBIE, associate editor of *Engineering and Mining Journal*, returned to New York on March 26 from a trip through the Arizona mining districts. Mr. Robie's impressions of the Arizona industry will appear from week to week in the news columns of *E. & M. J.*

H. RUSDEN and J. HENDERSON, of the Witwatersrand Co-operative Smelting Works, presented a joint address on "Speiss and the Metals of the Platinum Group" before the Chemical, Metallurgical and Mining Society of South Africa at a recent meeting in Johannesburg.

W. A. SLATER has been appointed research professor of engineering materials and director of the Fritz Engineering Laboratory at Lehigh University. Professor Slater holds the degrees of bachelor of science, master of science, and civil engineer from the University of Illinois.

ARTHUR LOWY, for many years vice-president and chief engineer of the New York Engineering Company and who has been with the company since its inception, has been elected president to succeed A. C. LUDLUM, who died recently. F. N. LUDLUM has been elected vice-president. GEORGE SOMMER, who has been with the company for sixteen years, has been elected secretary and treasurer.

WALDEMAR LINDGREN, of the geological department of the Massachusetts Institute of Technology, addressed the San Francisco meeting of the American Association of Petroleum Geologists on March 21, 1928. He spoke about the plan of the Division of Geology and Geography of the Research Council to work out a bibliography of economic geology. It is planned to secure funds to the amount of $18,000 to $24,000 with which to finance the project for several years at the start, when it is believed that sufficient funds will be secured to continue the work.

HERBERT HOOVER has been appointed a member of the Endowment Committee of the Engineering Foundation and the Engineering Societies Library and its executive sub-committee. Mr. Hoover, in addition to being a former president of the A.I.M.E., is an honorary member of the American Society of Civil Engineers and of the American Society of Mechanical Engineers. These societies, together with the American Institute of Electrical Engineers, maintain the Engineering Foundation and the Engineering Societies Library. The Endowment Committee is seeking to increase the Foundation's endowment by $5,000,000 for the purpose of undertaking additional work in applied science outside the field of activities of industrial and governmental research laboratories. Engineering Societies Libraries, one of the largest technical libraries in the world, needs a $2,000,000 endowment to cope with the increasing demands for its service.

Market and Financial News

St. Joe Lead Earnings Decline from 1926

EARNINGS of the St. Joe Lead Company in 1927 were materially affected by the lower price of lead and curtailment in production. Earnings, after deducting all charges for depreciation, depletion, and reserve for federal taxes, were $4,027,125, compared with $8,216,825 in 1926 and $9,573,146 in 1925.

The mines and mills in St. Francois County, Mo., produced 4,527,695 tons of ore, 208,381 tons of lead concentrate, and 8,390 tons of zinc concentrate. The lead content of the lead concentrate produced was 151,045 tons.

There was produced by Kansas Explorations, Inc., a subsidiary of this company, from its properties in the Tri-State district, 496,610 tons of ore, 2,522 tons of lead concentrate, and 26,492 tons of zinc concentrate.

The Edwards mine, in New York State, produced 7,705 tons of zinc concentrate.

Production at Mine La Motte began in February, 1927, amounting to 123,018 tons of ore, from which there was produced 10,845 tons of lead concentrates at the company's St. Francois mills. A mill is now under construction at Mine La Motte.

During the year the company increased its investments in mining property by the acquisition of interests in Montana and has abandoned its active exploration in Bolivia.

Federal income taxes amounting to $1,327,226 were paid in 1927.

St. Joseph Lead Company and Subsidiary Companies Consolidated Balance Sheet, Dec. 31, 1927

Assets		
Capital assets		
Ore reserves and mineral rights, including appreciation arising from revaluation	$32,693,420.63	
Less reserve for depletion	21,589,963.36	$11,103,457.27
Buildings, plant and equipment	$16,960,888.23	
Less reserve for depreciation	4,969,504.10	11,991,384.13
Railroad property and equipment	$3,748,544.44	
Less reserve for depreciation	720,959.14	3,027,585.30
		$26,122,426.70
Investments		
Sundry securities and loans	$1,046,303.29	
Mine La Motte lease	281,158.89	
		$1,327,462.18
Current and working assets		
Inventories at cost		
Lead and zinc	$1,329,600.45	
Materials and supplies	1,977,987.21	
	$3,307,587.66	
Accounts receivable	1,481,460.20	
Collateral loans	1,658,472.38	
Marketable securities	7,981,847.10	
Cash in banks, on hand and in transit	2,742,589.00	$17,171,956.34
Deferred charges		
Prepaid insurance, taxes		362,643.93
		$44,984,488.93
Liabilities		
Capital stock		
Authorized 2,000,000 shares of $10 each	$20,000,000.00	
Issued—1,996,770 shares	19,967,700.00	
Less in treasury—46,332 shares	463,320.00	
	$19,504,380.00	
Scrip outstanding	708.50	$19,505,088.50
Minority interest in subsidiary companies:		
Capital stock, par value	235,860.00	
Proportion of surplus applicable thereto	27,169.30	$263,029.30
Purchase money obligations, payable in annual amounts to Sept. 30, 1930		522,500.00
Current liabilities:		
Accounts payable	$1,273,297.31	
Wages accrued	114,591.97	
Provision for 1927 federal income tax	781,098.84	
	$2,168,988.12	
Dividends declared, payable quarterly in 1928	5,851,314.00	8,020,302.12
Reserve for contingencies (including federal taxes of prior years)		1,819,579.12
Surplus, per statement attached		14,853,989.89
		$44,984,488.93
Surplus Account, Dec. 31, 1927		
Surplus at Dec. 31, 1926, including surplus arising from revaluation of ore reserves and mineral rights		$16,678,197.22
Profit from operations for the year ending Dec. 31, 1927, after writing off development and exploration expenses on properties abandoned but before providing for depreciation, depletion and federal income tax	$7,324,904.37	
Add interest, dividends, and miscellaneous income	957,405.56	
	$8,282,309.93	
Deduct provision for		
Depreciation	$967,636.34	
Depletion	2,438,521.67	
Federal income tax	781,098.84	4,187,256.85
		$4,095,053.08
Deduct proportion of profit applicable to minority interests	67,928.41	4,027,124.67
		$20,705,321.89
Deduct dividends declared, payable quarterly during 1928		5,851,332.00
Surplus at Dec. 31, 1927		$14,853,989.89
Note—the above surplus comprises		
Surplus as shown by balance sheet of parent company at Dec. 31, 1927	$13,080,430.14	
Accumulated surplus of subsidiary companies, including that arising from revaluation of ore reserves and mineral rights, in excess of surplus reflected on books of parent company	1,773,559.75	
	$14,853,989.89	

Burma Corporation Reports £299,197 Surplus for Quarter

Burma Corporation, Ltd., during the quarter ending Dec. 31, 1927, milled 81,500 tons of ore, assaying silver, 21.6 oz.; lead, 24.4 per cent; zinc, 15.3 per cent. Shipments from the mine were as follows:

	Tons	Silver, Oz.	Lead	Zinc	Copper
Ore to mill	78,564	21.7	24.4	15.4	0.57
Lead ore to smelter	7,638	27.8	35.7	13.0	0.44
Total lead ore	86,202	22.2	25.4	15.1	0.56
Copper ore to smelter	19,312	19.0	12.8	9.0	5.97
Grand total	105,514	21.6	23.1	14.0	1.55

Operation continued successfully at the company's experimental zinc flotation plant, and 14,513 tons of zinc concentrate was produced during the quarter assaying silver, 11.9 oz. per ton; lead, 7.1 per cent; zinc, 49.1 per cent. Development work totaled 1,177 ft.

Estimated revenue and expenditure for the quarter are shown in the following table:

Gross revenue	£826,177
Operating expenditure	526,980
Surplus over working expenditure	£299,197
Income and super tax	48,990
Plant and equipment depreciation	59,512
Capital expenditure	20,730

The sterling figures shown are based on the rate of exchange, 13.3 rupees to the pound.

PHOSPHATE ROCK sold or used by producers in the United States in 1927 was 3,166,102 long tons, valued at $11,234,863, according to figures compiled by the U. S. Bureau of Mines. The compilation indicates a decrease of 1 per cent in quantity and an increase of 3 per cent in value, as compared with 1926. The quantity and value, by states, in 1927 were as follows:

	Long Tons	Value
Florida:		
Hard rock	131,254	$525,016
Land pebble	2,506,166	8,121,146
	2,637,420	$8,646,162
Idaho:		
Western rock	45,260	259,405
Tennessee:		
Blue and brown rock	477,172	2,300,296
Wyoming:		
Western rock	6,250	29,000
	3,166,102	$11,234,863

Noranda Ore Reserves Estimated at $27,475,000

THE fifth annual report of Noranda Mines, Ltd., for the year ended Dec. 31, 1927, shows ore reserves amounting to 1,198,375 tons, averaging 6.73 per cent copper and $5.44 in gold, with a gross value of $27,475,000, taking the copper at 13c. a pound. This is an increase of over $2,000,000 compared with the preceding year, but in 1927, as in 1926, no estimate has been made of ore below the 300 level, as the small amount of development work below that level was not sufficient to determine definitely the size or values of the orebodies encountered.

The smelter was in operation only the last thirteen days of the year, and the metal balance sheet shows that 10,740 tons was shipped to the smelter, averaging: copper, 8.18 per cent; gold, $5.42 per ton; and silver, 1.0 oz. The estimated smelting loss amounted to 6.24 per cent. During the period, however, the Cottrell system was not in operation, and it is believed that the total losses will eventually be reduced to 5 per cent. The only diamond drilling below the 300 level, during 1927, was on the "D.," "K." and "E." orebodies.

The report states that development at 400 and 500 ft. is now at the same stage as the 300 level two years ago. At that time only the "B" orebody had been found, but since then four others have been opened up at 300 ft. Geologists say that the chalcopyrite has replaced the pyrrhotite, and it is to be expected that on the different horizons there will be variations in the grade of the orebodies—that is, with depth rich orebodies may get poorer on certain horizons, and, on the other hand, low-grade orebodies may become richer. So many sulphide bodies have been found on the property that it is reasonable to suppose these will be met with at the lower levels, and places will be found where the pyrrhotite has been largely replaced by chalcopyrite. There is no geological reason at present known which would lead to any other conclusion, and diamond drilling has already shown that commercial orebodies exist between the 700 and 800 ft. levels. The consolidated balance sheets show a capital surplus of $6,640,000; cash and current assets amount to $1,053,563; shares in other companies at cost amount to $1,675,000; capital expenditures amount to $8,292,000. Current liabilities are $235,000, and there are $3,000,000 of 7 per cent bonds outstanding.

SHANGHAI SILVER STOCKS totaled 111,800,000 taels on March 8, according to U. S. Department of Commerce radiogram from its Shanghai office. This compares with 107,800,000 taels on March 1.

RIO TINTO COMPANY, LTD., recently declared a final dividend, for 1927, of 30s. on the common shares, less tax, making a total of 50s. for the year. The balance carried forward by the company amounted to £150,000.

GOLD MINES of the Province of Ontario milled a total of 377,159 tons of ore in January, 1928, compared with 369,161 tons the previous month and 343,180 tons in January, 1927. Bullion to the value of $2,983,355 was recovered in January, a considerable drop from the $3,400,463 recovered in December from a smaller amount of ore, though greater than the $2,527,262 recovered in January, 1927, according to the U. S. Department of Commerce. In the Porcupine district ore to the extent of 294,343 tons was milled in January, 1928, by the seven producing mines, bullion being recovered to the value of $1,956,969. This is an increase in both tonnage and value over January, 1927, but as compared with the monthly average for 1927, it represents a decrease of about $17,000 in value, though an increase of about 4,000 tons. There were ten producing mines in Kirkland Lake in January, the Gold Hill Mine, with a 70-ton mill, being the latest addition. These mines produced ore to the extent of 82,816 tons, with a value of $1,026,386, a substantial increase in both tonnage and value over January, 1927, and the monthly average for 1927.

TRANSVAAL GOLD output month of January last was declared by the Chamber of Mines as 843,857 oz., equal in value to £3,584,477. As compared with December these figures show a decrease of 7,368 oz., equal to £31,297. The Native Labor Association returns show 193,063 "boys" working on the Rand gold mines on Jan. 31, an increase of 4,547 compared with Dec. 31, 1927.

Park Utah Reports Higher Earnings in 1927

THE annual report of the Park Utah Consolidated Mines Company, operating in the Park City district, Utah, reveals the establishment of a new record for earnings in 1927. This is a notable achievement in view of the lower metal prices prevailing throughout the year. Increased efficiency and economy in mining operations, together with a larger metal production, are important influences in the new high record.

The record year, 1926, has been eclipsed by a material increase in tonnage and metal output. The production of the combined properties follows:

	1927	Increase Over 1926, Per Cent
Tons mined	394,303	17
Lead, lb.	50,054,168	23
Zinc, lb.	49,569,591	22
Copper, lb.	2,540,697	29
Gold, oz.	38,761	92
Silver, oz.	4,997,078	(a) 4

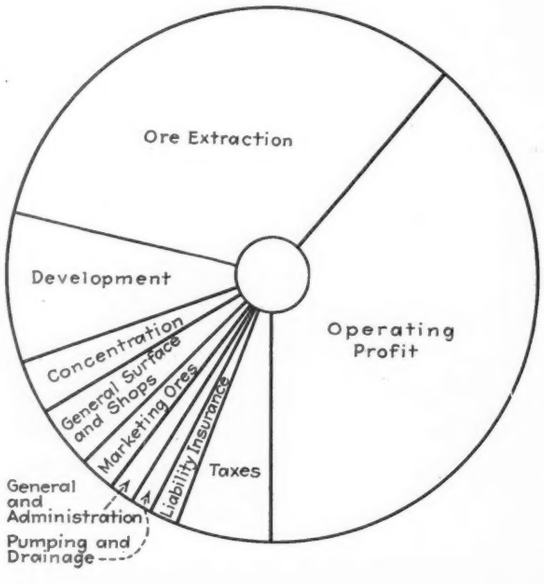
(a) Decrease.

The average value of the combined ores sold, after smelting charges and freight, was $14.08 per ton.

Condensed profit-and-loss data for 1927 follow:

Income		
Ore sales	$4,169,005	
Interest on investments, loans and bank deposits	114,590	
Miscellaneous income	12,187	
Total income		$4,295,783
Expense		
Mine operating expense	$1,800,225	
Ore expense	87,798	
Development expense	287,969	
Mill operations	133,663	
	$2,309,657	
Administrative and general expense	52,690	
Property taxes	131,466	
Corporation license taxes	500	
Income tax, 1927	109,476	
		2,603,790
Income before depreciation and depletion		$1,691,993
Less Depreciation		122,656
Net income		$1,569,336
Dividends paid, 1927		$1,569,125

An important comparison indicated by the foregoing table is observed between the items "gross income from ore sales," which in 1926 was $4,312,766 and in 1927 was $4,169,005. In spite of this decrease in gross income from ore sales, net earnings show an appreciation, which reflects the improvement in operating efficiency during 1927.



Distribution of Gross Receipts of the Park Utah Consolidated Mining Company

A commendable feature of the report is the abundant use of charts and graphs to portray clearly the condition of the enterprise. The accompanying illustration shows clearly the allocation of gross receipts.

The Market Report

Huge Copper Market Both Here and Abroad

New York, March 28, 1928 — An enormous demand for copper, which developed to its fullest extent yesterday, was the feature of the metal markets in the week ending today. Lead experienced fully normal activity. The other non-ferrous metals were fairly quiet, with prices generally well maintained. The continued excitement in the stock market, with further inflated quotations and sales on the 26th and 27th exceeding 4,000,000 shares for the first time on record, apparently had little effect on the commodity markets as a general rule. Prospects are improving for increasing industrial activity in the spring and early summer, which should result in increased metal consumption.

Daily Prices of Metals

Mar.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
22	13.875	52.875	53.50	6.00	5.80	5.70
23	13 90	53.125	53.75	6.00	5.80@5.825	5.70
24	13.90	52.875	53.50	6.00	5.80@8.825	5.70
26	13.875	52.375	53.00	6 00	5.80@5 825	5.70
27	13.90	52.25	52.875	6.00	5.825	5.675@5.70
28	13.90	52.25	53.00	6.00	5.85	5.675@5.70
	13.892	52.625	53.271	6.000	5.819	5.696

Average prices for calendar week ending March 24, 1928, are: Copper, 13.852; 99 per cent tin, 52.583; Straits, 53.292; N. Y. lead, 6.000; St. Louis lead, 5.804; zinc, 5.677; and silver, 57.375.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary form of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Mar.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
22	61⅜	61⅜	66½	238½	238¼	20⅜	20¼	25⅛	25
23	61¼	61 5/16	66½	240¼	239¾	20 3/16	20 9/16	25 3/16	25
26	61⅜	61 7/16	66½	239½	238¾	20⅜	20½	25 3/16	25 1/16
27	61 9/16	61⅜	66½	239 7/8	239¼	20	20 7/16	25⅛	25
28	61⅜	61¾	66½	238	237¼	20	20 7/16	25	24 15/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver		Gold London	Mar.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
22	4.87¾	57½	26½	84s11½d	26	4.87¾	57¼	26 7/16	84s11½d
23	4.87 13/16	57⅜	26⅜	84s11½d	27	4.87⅞	57¼	26 7/16	84s11½d
24	4.87¾	57¼	26⅜	.....	28	4.87 11/16	57¼	26 5/16	84s11½d
					Avg.		57.292		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Copper Producers Sold Out at 14⅛c., Delivered

The copper market, which had been little better than average for the last month, and extremely dull for many weeks before that, gradually improved until yesterday, when the long-nurtured bud broke forth into full bloom with an avalanche of orders that quickly brought every seller up to the full 14⅛c. Valley quotation. Wire and brass mills fell over themselves to place orders for April and May delivery, as the producers, armed with the data of the Copper Institute, knew they would have to do. The good business done with the wire manufacturers was particularly pleasing to the sellers. By late yesterday afternoon at least one producer had sold all he cared to at the current quotation and advanced to 14¼c. for Connecticut deliveries. Today, others have gradually come to the same level as the buying wave has continued. Total sales for the week have exceeded those of any week since that of Dec. 8, 1926.

The foreign demand for copper was also excellent yesterday—over 6,000 long tons—and this may have been the spark which touched off the local market. The March shipments are extremely good, following the comparatively low figures for January and February, so that the foreign consumption in the first quarter promises to be up to normal after all. The foreign price continues unchanged at 14½c., c.i.f.

Primary copper producers are complimenting themselves, and are being complimented by manufacturers, for their success in maintaining a stable copper market for the last three months; it is the first time that the desires of practically every one in this connection have been successfully carried out in the face of a long-continued quiet market.

Lead Active; Prices Firmer

Good inquiry and active buying have characterized the domestic lead markets, both in the East and in the Middle West. Small premiums over the contract price of the American Smelting & Refining Company, which has remained at 6c. New York, have been obtained, but the tonnage is not sufficiently large to be reflected in quotations. The leading interest, however, during the last two days has been unwilling to entertain business at the 6c. level for delivery beyond April. In the Middle West the principal seller on Monday advanced its price from 5.80c. to 5.825c., and today is unwilling to accept less than 5.85c. "Outside" interests obtained premiums on small shipments last Friday and Saturday. Though London has declined slightly since last Thursday, the sharp advance on that day was enough to effect a net advance for the week. Except for corroders, virtually all classes of buyers are represented, including cable, battery, ammunition, foil, and mixed-product manufacturers. A fea-

ture was unusual activity on the part of buyers of one- or two-carload lots. Taken altogether March has been an excellent month for lead producers from the standpoint of tonnage, at least, and domestic sellers are in a comparatively comfortable position.

Narrow Market for Zinc

Zinc is slightly improved in price over a week ago, having stuck close to 5.70c. for most of the week. Yesterday and today this price was shaded from 2½ to 5 points for prompt shipment. The market is narrow and sensitive, and if a large tonnage was required to be bought or sold, the price would easily be affected. World production for last month was at a record rate for all time, which does not encourage sellers to expect much higher prices.

Little Activity in Tin

Domestic consumers of Straits tin have bought only limited amounts during the week ending today, although the price has declined slightly. The buying on this side last week reacted on the oversold market in London. However, when the speculative position was adjusted, they looked again to the United States for support, but found little forthcoming. Though there is some shrinkage in shipments of Banka, the current supply is apparently ample, and the fluctuations in the market are not caused by fundamental changes. Straits for future delivery is about ⅛c. under prompt; and prices for 99 per cent continue to be nominal in the absence of buying.

Silver Is Steady at 57¼c.

During the last week the silver market fluctuated within narrow limits and is quoted steady at the present level. Moderate buying for India and lack of pressure to sell have been the supporting features.

Mexican Dollars (Old Mexican pesos): March 22d, 44⅛c.; 23d, 44c.; 24th and 26th, 43⅞c.; 27th, 43¾c.; 28th, 43⅞c.

Foreign Exchange Steady

Little change is noted in Sterling or the other principal foreign exchanges. Closing cable quotations on Tuesday, March 27, were: francs, 3.93 11/16c.; lire, 5.28⅜c.; and marks 23.915c. Canadian dollars are ⅞ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

ALUMINUM—Per lb., 98 or 99 per cent grades, price of leading interest, 24.30c.; outside market, 23.90@24.30c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, for all positions, 9¾c.

Cookson's "C" grade, spot, 15⅜c. Needle antimony nominally 7¼c. for lump and 10c. for powdered. White oxide, Chinese, 99 per cent Sb_2O_3, 11¼c.

BISMUTH—Per lb., New York, in ton lots, $2.10. Smaller lots, $2.25 and up.

IRIDIUM — Per oz., $290@$315 for 98@99 per cent sponge and powder. Market dull, prices largely nominal.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $49@$52. Small lots bring up to $56. Absolutely no activity in market.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $80. Dealers and refiners quote the trade for refined metal, per oz., cash, $74@$78. Market very dull.

QUICKSILVER — Per 76-lb. flask, $123@$124, depending on quantity. San Francisco wires $122.33.

Prices of Cadmium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of March 3.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn. c.i.f. North Atlantic ports, minimum 47 per cent Mn: 35@38c. Caucasian, washed, 53@55 per cent, 38@40c. Chemical grades unchanged from quotations in the March 3 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.; Wolframite. $10.25@$10.50. Western scheelite, $10.50@$10.75. Prices nominal.

Chrome, Iron, Tantalum, and Titanium ores are unchanged from quotations in the March 3 issue.

Zinc, $38; Lead, $72.50

Joplin, Mo., March 24, 1928

Blende

High		$40.90
Premium blende, basis 60 per cent zinc	$39.00@	40.00
Prime Western, basis 60 per cent zinc		38.00
Slimes and fines, basis 60 per cent zinc	34.00@	37.00
Average settling price, all zinc		37.19

Galena

High	$76.80
Basis 80 per cent lead	72.50
Average settling price, all lead	74.27

Shipments for the week: Blende, 10,498; lead, 1,062 tons. Value, all ores the week, $471,270.

At 4 o'clock this afternoon buyers and sellers of zinc concentrate are in a deadlock, buyers offering but $38, basis, Prime Western, and sellers declining to accept. Information at this hour indicates that sales will not reach 5,000 tons, with little prospect of either side weakening.

At 5 o'clock buyers reported 4,990 tons bought, with very slight prospect of this being increased, though some buyers would hold the market open until 6 o'clock, or even later.

Lead shipments were slightly heavier, the movement being largely from smelter-owned mines.

Platteville, Wis., March 24, 1928.

Zinc Blende	Per Ton
Blende, basis 60 per cent	$42.75
Lead Ore	
Lead, basis 80 per cent lead	$72.50

Shipments for the week: Blende, 872 tons; lead, none. Shipments for the year, blende 8,706 tons; lead, 560 tons. Shipments for the week to separating plants, 1,504 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the March 3 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. Market quiet.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the March 3 issue.

Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $100 quoted for second quarter, 1928. Spiegeleisen, 19@21 per cent, $32 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 92@95c. f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the March 3 issue.

Metal Products

ROLLED COPPER, LEAD SHEETS, NICKEL SILVER, and YELLOW (MUNTZ) METAL are unchanged from quotations in the issue of March 24.

ZINC SHEETS — 8½c. per lb., f.o.b. works, effective March 26.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of March 3.

Iron, Steel, and Coke

Iron—Per gross ton, Valley furnaces, Bessemer, $17.25@$17.50; basic, $17; No. 2 foundry, $17.25.

Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33; plates, structural shapes, and soft steel bars, per pound, 1.85@1.90c.

Coke—Per gross ton, Connellsville furnace, contract, $2.85@$3; spot, $2.60@$2.85. Connellsville foundry, contract, $3.75@$4.25; spot, $3.75@$4.25. By-product coke, Ohio and Kentucky, $7.50; Buffalo and Detroit, $8.50@$9.

Current Prices of Mining Supplies

Rise and Fall of the Market

UPWARD tendency persists in prices of mining supplies, according to comparisons with levels of a month ago. Steel shapes, railway spikes and wire nails are higher than in February. There is also improvement in demand, with prices firmer, in lumber, tile, paint materials and rope. Steel sheet demand is weak. Cast-iron pipe quotations, though $1 per ton below February, show firmness with tendency to rise as seasonal buying continues to improve.

SHEETS—Quotations are per 100 lb. in various cities delivered from warehouse, also the base quotations at mill:

	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
Galvanized No. 24	$3.75	$5.25	$4.80	$5.45	$4.95

STEEL RAILS—The following quotations are per gross ton f.o.b. Pittsburgh, Chicago and Birmingham in carloads:

	Pittsburgh	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	$43.00
Standard open hearth rails	43.00	43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carloads, together with the warehouse prices at other places named:

	Pittsburgh	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.75–$2.80	$3.55	$3.65	$3.85	$3.00
Track bolts	3.80	4.55	4.65	5.35	3.90
Standard section angle bars, splice bars or fish plates	2.75	3.40	4.25	4.25	....

STRUCTURAL MATERIAL—Following are base prices per 100 lb. in carloads, f.o.b. mill, Pittsburgh and Birmingham. At other cities listed, quotations are per 100 lb., delivered from warehouse:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.90	$1.90@2.00	$3.34	$4.00	$3.25	$3.10	$3.15
Channel, 3 to 15 in.	1.90	1.90@2.00	3.34	4.00	3.25	3.10	3.15
Angles, 3 to 6 in., ¼-in. thick	1.90	1.90@2.00	3.34	4.00	3.25	3.10	3.15
Tees, 3 in. and larger	1.90	1.90@2.00	3.34	4.00	3.35	3.10	3.15
Plates ¼-in. thick	1.90	1.90@2.00	3.34	4.00	3.25	3.10	3.15

WIRE ROPE—Discounts from list price, f.o.b. New York and territory east of Missouri River, on regular grades of bright and galvanized are as follows:

Cast steel round strand rope	20 %
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5 %
Plow steel round strand rope	35 %
Special steel round strand rope	30 %
Gavanized iron rigging and guy rope (add to list)	12½%

DRILL ROD (from list at warehouse)

New York	Cleveland	Chicago
60%	55%	50%

WROUGHT IRON AND STEEL PIPE—The following discounts from list are to jobbers for carloads at Pittsburgh mill:

	Steel			Iron		
	Inches	Black	Galv.	Inches	Black	Galv.
Butt Weld	1 to 3	62	50½	1 to 1¼	30	13
Lap Weld	2½ to 6	59	47½	3 to 6	28	13

WROUGHT-STEEL PIPE—From warehouses at the places named the following discounts from list hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
2½ to 6 in., lap welded	48%	51%	46%

CAST-IRON PIPE—The following are prices on class B, and heavier, f.o.b. per net ton, for carloads.

	Birmingham	New York	Chicago	St. Louis	San Francisco
6 in. and over	$27.00	$36.60	$37.20@$39.20	$32.60	$38.00

NUTS—Hot pressed or cold punched, square or hexagonal, blank or tapped, up to 1-in., inclusive, full packages, carry a discount of 55% from new list, April 1, 1927, on immediate deliveries from warehouse stocks in New York and vicinity.

HOLLOW TILE—Price per block to contractors, in lots of 2000 pieces or over:

	New York	Chicago	Philadelphia	St. Louis	San Francisco‡	Perth Amboy N. J., Factory
4x12x12	$0.1004	$0.076	$0.11	$0.068	0.108	
6x12x12	.1506	.104	.....	.09	.156	$0.252*
8x12x12	.1883	.142	.22	.126	.244	.342†

*10x12x12; † 2x12x12.

MACHINE BOLTS—Square heads and nuts, up to 1x30-in. full packages, discount 50% from new list April 1, 1927, at warehouses in New York and vicinity.

LUMBER—Prices per M ft. b.m., in carloads to contractors:

San Francisco—Rough Douglas fir, No. 1 common

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$29.00	$30.00	$31.00	$34.00
3x6 and 8	29.00	30.00	31.00	34.00
4x4-6 and 8	29.00	30.00	31.00	34.00

New York—Prices are for long-leaf pine timbers (rough) delivered to job.

	New York		Chicago	
	20 Ft. and under	22-24 Ft.	Up to 20 Ft., Pine	Up to 32 Ft., Fir*
3x4 to 8x8	$46.00@48.00	$47.00@49.00	$38.00	$39.50
3x10 to 10x10	53.00@55.00	54.00@56.00	45.00	39.50
3x12 to 12x12	60.00@62.00	61.00@63.00	55.00	39.50

Other Cities—Price for rough timbers:

	8x8-In. x 20 Ft. and Under				12x12-In.† 20 Ft. and Under	
	Pine	Fir*	Hemlock	Spruce	Pine	Fir*
Boston	$48.75	$47.50	$49.00	$52.00	$57.50	$57.00
Cincinnati	33.00	46 00	44.00	44 00	37.00	50.00
Denver	.....	33.75	32.75	32.75	33.75	33.75
Minneapolis	44.25	37.50	36.25	.....	48.25	38.25
Kansas City, Mo.	40.50	38.75	.....	.....	54.50	38.75
Philadelphia	48.00	35.00	40.00	45.00	60.00	35.00

*Douglas fir. †3x12 to 12x12 100 lb. Chicago price is on S4S.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.65	$3.15	$3.40	$4.25	$2.83	$4.95
Cut	2.80	.....	4.90	5.00	2.88	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without charge for bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.25@2.35	$2.25@$2.35	$2.35@$2.50
Chicago, f.o.b.	2.05	2.05	2.05
Cleveland, f.o.b.	2.24	2.24	2.24

LIME—Warehouse; New York quotes bbl. 280 lb. net; Chicago, 180 lb.:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$17.20@18.20	$12.10	$3.25@3.50	$2.10@$2.50
Chicago	20.00	18.00	.....	1.50

LINSEED OIL—These prices are 7½-lb. per gallon:

	New York	Chicago	Minneapolis
Raw in barrels (5 bbl. lots)	$0.76½	$0.78	$0.87

WHITE AND RED LEAD—Per 100-lb. keg base price, f.o.b. New York.

	Dry	In Oil
Red	$13.75	$15.25
White	13.75	13.75

HOSE—Quotations at New York warehouses:

Fire Protection — Underwriters' 2½-in. coupled, single jacket (net) — 50-Ft. Lengths $0.68 per ft.

Air—Best Grade — ¾-in., per ft. — 3 ply $0.36½ — 4 ply $0.44

Steam—Discounts from List — First grade 30–10% — Second grade 40% — Third grade 45%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. for rubber transmission belting. Discounts from list are as follows:

Best grade 45% — Second grade 50%

LEATHER BELTING—List price, 24c. per lin.ft. per inch of width for single ply, at New York warehouses:

Grade	Discount from list
Medium	35%
Heavy	30%

PACKING—Prices per pound at New York warehouse:

Rubber and duck for low-pressure steam, ⅛ in.	$0.95
Rubber sheet	.50
Rubber sheet wire insertion	.80

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils

Atlanta	$0.22	New Orleans	$0.23½
New York	.26	Seattle	.23
Chicago	.22	San Francisco	.23½

EXPLOSIVES—Prices per pound for dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.265	$0.2875
Minneapolis	.1917	.2123
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.22	.245
San Francisco	.1625	.1925

FLOTATION OIL—Pine tar, 50 gal. bbl., gross weight 500 lb., f.o.b. New York carload lots, per gal. $0.33

CHEMICALS—Prices for round lots in New York market, per lb.:

Zinc dust, 550 lb. casks	$0.09@.10
Litharge, casks	.08½
Sodium cyanide, 220 lb. single case lots	.18@.22
alcium carbide, in drums	.05@.06

Mining Stocks—Week Ended March 24, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	57⅞	54½	56⅝	Ja.14, Fe.20 Q	0.75
Arcadian Consol.	Boston	...	...	5¼	...	...
Ariz. Com'l.	Boston	4¼	3½	4	Ja. 19, Ja. 31	0.25
Cal. & Ariz.	New York	95½	91½	94	...	...
Calumet & Hecla	Boston	21⅝	20⅜	21	No.30, De.15 Q	0.50
Cerro de Pasco	New York	66⅛	63	65½	Ja.12, Fe.8 Q	1.00
Chile Copper	New York	40	38½	39⅝	Ma. 2, Ma.30 Q	0.26
Con. Copper mines	N. Y. Curb	9⅛	8½	9⅞	...	...
Copper Range	Boston	17	15	15¼	Ap.2, Ma.2, A	1.00
Crystal Copper	Boston Curb	*59	*44	*56	...	...
East Butte	Boston	1⅛	1⅛	1⅛	Dec., 1919	0.50
Granby Consol.	New York	43⅝	42½	43¼	Jn.15 Jy.1 Q	1.00
Greene Cananea	New York	129⅝	121¼	124½	Nov., 1920	0.50
Howe Sound	New York	47⅞	45	46⅛	Ma.31, Ap.16, Q	1.00
Inspiration Consol.	New York	20⅛	18⅛	19⅛	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	3½	3½	3½	...	...
Isle Royale	Boston	12½	12	12½	Fe.28, Ma.15	0.50
Kennecott	New York	84⅛	81⅛	83½	De.2, Ja.3 Q	1.25
Magma Copper	New York	50½	48⅛	48⅜	Ma.31, Ap.16 Q	0.75
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛	...	...
Miami Copper	New York	18½	18	18⅛	Fe.1, Fe.15, Q	0.37½
Mohawk	Boston	52	50	51	Ja.28, Ma.1 Q	1.00
Montana-Idaho	Spokane	*46	*42	*42½	...	...
Mother Lode Coal	New York	3½	3	3	De.16, De.31	0.25
Nevada Consol.	New York	20⅛	19⅛	20	Ma.16, Ma.31 Q	0.374
New Cornelia	Boston	26½	26½	26½	Fe.3, Fe.20 Q	0.50
Noranda	N. Y. Curb	19	18	18⅛	...	...
North Butte	Boston	1.00	*90	*90	Oct., 1928	0.25
Ohio Copper	N. Y. Curb	...	...	*81	Sept., 1926	0.03
Old Dominion	Boston	9⅛	9	9⅛	Dec., 1928	1.00
Phelps Dodge	N. Y. Curb	122½	121¼	122⅜	De.17, Ja.3 Q	1.50
Quincy	Boston	13	12½	12⅞	March, 1920	1.00
St. Mary's Min. Ld.	Boston	27½	23½	25	Fe.10, Ma.10	2.00
Seneca Copper	New York	2½	2	2½	...	...
Shattuck-Denn	N. Y. Curb	16⅝	13⅜	15⅝	...	...
Tenn. C. & C.	New York	11½	10⅜	11	Fe.29, My.15,Q	0.12½
United Verde Ex.	N. Y. Curb	20½	19⅛	20	Ap.6, My.1, Q	0.50
Utah Copper	New York	...	...	143	Ma.16, Ma.31 Q	0.50
Utah Metal & T.	Boston	...	...	1⅜	Dec., 1917	0.30
Walker Mining	Salt Lake	79*	*75	*79	...	...
NICKEL-COPPER						
Internat. Nickel	New York	98	90⅛	93	Ma.15, Ma.31Q	0.50
Internat. Nickel pfd.	New York	112	112	112	Fe.17, Ma.1 Q	0.62½
LEAD						
Gladstone Mtn.	Spokane	*9⅜	*8½	*9	June, 1927	0.005
National Lead	New York	130	127½	129½	Ma.16, Ma.31Q	1.25
National Lead pfd.	New York	144	139½	144	Ap.23, Ma.1 Q	1.50
National Lead,pfd. B.	New York	117½	112½	117½	...	...
St. Joseph Lead	New York	39	37½	38⅛	Ma.9, Ma.20,QX	0.75
ZINC						
Am. Z. L. & S.	New York	22¼	18⅜	21⅛	May, 1917	1.00
Am. Z. L. & S. pfd.	New York	84	78	81⅛	Nov., 1920	1.50
Butte C. & Z.	New York	6	5⅜	5⅜	De.9, De.24	0.50
Butte & Superior	New York	10⅛	9⅛	10	De.16, De.31 Q	0.50
Callahan Zn-Ld.	New York	2⅛	2	2⅛	Ma.14, Ma.31	0.50
Consol.Lead&Zinc 'A'	St. Louis	1⅛	1⅛	1⅛	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	16⅞	16	16⅛	No.15, De.1 Q	0.40
Eagle-Picher pfd.	Cincinnati	102	100	102	Jn.30, Oc.15 Q	1.50
New Jersey Zn.	N. Y. Curb	199	195	197⅞	Ja.20, Fe.10	2.00
Treadwell-Yukon	Toronto	28.50	27.10	28.00	...	...
United Zinc	N. Y. Curb	...	...	25	...	...
Yellow Pine	Los Angeles	*35	*25	*25	Dec., 1925 Q	0.04
GOLD						
Alaska Juneau	New York	4	3⅛	3⅛	...	...
Argonaut	Toronto	*19¼	*16	*17½	...	...
Barry-Hollinger	Toronto	1.25	1.11	1.17	...	...
Central Manitoba	Toronto	1.45	1.27	1.30	...	...
Con.W.Dome L. new.	Toronto	*13	*11	*13	...	...
Cresson Consol. G.	N. Y. Curb	2	2	2	Ma.31, Ap.10 Q	0.10
Dome Mines	New York	11	10⅛	10⅛	Ma.31, Ap.20 Q	0.25
Golden Cycle	Colo.Springs	†1.75	†1.74	...	Fe.29, Ma.10 Q	0.04
Gold Hill	Toronto	*25	*21½	*22½	...	...
Hollinger Consol.	Toronto	17.25	16.95	17.15	Ma.7, Ma.24	0.10
Homestake Mining	New York	73	71⅝	73	Ma.20, Ma.26 Q	0.50
Kirkland Lake	Toronto	2.12	1.92	2.00	...	...
Lake Shore	Toronto	23.85	23.10	23.50	Ma.1, Ma.15QX	0.20
McIntyre-Porcupine	New York	27⅛	27⅛	27⅛	Fe.1, Ma.1 Q	0.25
Portland	Colo.Springs	†*27	†*22	...	Ap.6, Ap.15 Q	0.02½
Rand Mines	New York	40⅜	40⅜	40⅜	Au.22-29 Am.Sh.	1.52
Sylvanite	Toronto	3.30	3.20	3.20	...	...
Teck-Hughes	Toronto	8.70	8.50	8.60	Fe. 1, X	0.15
Tom Reed	Los Angeles	*32	*30	*32	Dec., 1926	0.02
Tough-Oakes	Toronto	*57	*54½	*55	...	...
United Eastern	N. Y. Curb	*60	*53	*58	July, 1924	0.05
Vipond Cons.	Toronto	*99	*52	*91	Ap.1, Ap.15	0.03
Wright-Hargreaves	Toronto	5.25	4.90	4.95	Ja.17, Fe.1	0.05
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	27	24½	26	...	...
Con. Cortes	N. Y. Curb	...	...	*23	...	...
Dolores Esperanza	N. Y. Curb	...	...	*31	July, 1923	0.05
N.Y. Hond's Rosario	N. Y. Curb	16⅜	16⅛	16⅛	...	...
Premier Gold	N. Y. Curb	2⅜	2⅜	2⅜	Ma.15, Ap.4	0.08
Tonopah Belmont	N. Y. Curb	1 1/16	1 1/16	1 1/16	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*17	*13	*13	Apr., 1925	0.05
Tonopah Mining	N. Y. Curb	3⅛	3⅛	3⅛	Se.20, Oc.21	0.07½
West End Consol.	N. Y. Curb	...	...	*5	Mar., 1923	0.05
Yukon Gold	Boston Curb	...	...	*50	June, 1918	0.02
SILVER						
Beaver Consol.	Toronto	1.64	1.51	1.58	May, 1920	0.03
Castle-Trethewey	Toronto	*60	*55	*57	...	...
Coniagas	Toronto	4.95	4.75	4.95	May, 1924	0.12½
Keeley	Toronto	*68	*55	*61½	Ma.1, Ma.15	0.04
Lorrain Trout Lake	Toronto	*30	*30	*30	July, 1925	0.05
Mining Corp. Can.	Toronto	3.70	3.50	3.55	Ja.10, Ja.25	0.15
Nipissing	N. Y. Curb	5	4⅞	4⅞	Ma.31, Ap.20Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	5¾	4½	4⅝	Ma.25, Ap.4QX	0.12½
Bingham Mines	Boston	52	50⅜	50⅜	Ma.22, Ap.5 Q	1.00
Bunker Hill & Sullivan	N. Y. Curb	149¼	145½	145½	Fe.29, Ma.5QX	0.75
Cardiff M. & M.	Salt Lake	*34	*34	*34	Feb. 5, 1927	0.10
Chief Consol.	Salt Lake	3.80	3.65	3.65	Ja.10, Fe.1 Q	0.10
Consti'n Mng.&Mill'g.	Spokane	*20	*15	*20	...	...
Erupcion	Boston Curb	*40	*30	*31	De.17, Ja.3 Q	0.07½
Eureka Lily	Salt Lake	1.90	1.60	1.85	...	...
Federal M. & S.	New York	...	...	140	Jn.25, Jn.29 Spec.	$10
Federal M. & S. pfd.	New York	95	94½	94½	Fe.24, Ma.15 Q	1.75
Hecla Mining	N. Y. Curb	16	15⅞	16	Fe.15, Ma.15 Q	0.25
Highland-Surprise	Spokane	*14	*13½	*14	...	...
Iron King Mining	Salt Lake	*61	*60	*61	...	...
Keystone Mining	Salt Lake	...	...	*35	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*42	*38	*38	...	...
Lucky Tiger-Com.	KansasCity	†8.00	†7.80	...	Ma.10, Ma.20X	0.07
Mammoth Mining	Salt Lake	1.50	1.50	1.50	Jn.10, Jn.20 Q	0.05
North Lily	Salt Lake	6.30	5.90	6.20	...	...
Park Utah	New York	11⅜	10½	10½	Ma.15, Ap.15 Q	0.20
Plutus Mining	Salt Lake	*25	¼25	*25	Oc.25, No.10 Q	0.10
Silver King Coal	Salt Lake	11.00	10.37	10.50	Ma.20, Ap.2	0.25
Silversmith	Spokane	*20⅜	*18	*19	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*46	*42	*45	...	...
Sunshine M. Co.	Spokane	1.28	1.20	1.25	Fe.10, Fe.20	0.02
Tamarack-Custer	Spokane	1.00	*90	*90	Sept., 1924	0.25
Tintic Standard	Salt Lake	14.00	13.62½	13.75	Ma.21, Ma.29Q	0.30
Utah-Apex	Boston	4⅛	4	4	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	61⅜	59⅛	59½	Se. 2, Oc. 1.	1.75
Cleveland-Cliffs Iron.	Cleveland	120	111	114½	Ja. 13, Ja. 25. Q	1.00
Colorado Fuel & Iron	New York	81⅜	76½	76⅝	May, 1921	0.75
Gt. North'n Iron Ore.	New York	22⅛	22	22½	Dec. 6, Dec. 28	0.75
Inland Steel	New York	51	50	50½	Fe. 15 Ma. 1 QX	0.66⅔
Republic I. & S.	New York	61⅜	60	60	Fe. 15, Ma. 1 Q	1.00
Republic I. & S. pfd.	New York	109	108	109	Ma. 15, Ap. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	128⅜	126	128⅜	De. 10, De. 20 Q	1.50
Sloss-Snef. S.&I. pfd.	New York	123	118	123	De. 20, Ja. 3 Q	1.75
U. S. Steel	New York	152	144⅜	147⅛	No. 30, De. 30 Q	1.75
U. S. Steel, pfd.	New York	145⅜	140⅛	145¾	Oc. 30, No. 29 Q	1.75
Virginia I. C. & C.	New York	....	....	34	Jan., 1924	1.50
Virginia I.C.&C. pfd.	New York	....	....	62	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol.	New York	27	27	27	Jn. 26, Jn. 30	1.45
So. Am. G. & P. New.	N. Y. Curb	3⅛	3	3	...	...
Alum. Co. of Amer.	N. Y. Curb	126	125	126	...	...
Alum. Co. of Amer. pf.	N. Y. Curb	109	107⅜	109	Ma. 15, Ap. 1 Q	1.50
Vanadium Corp.	New York	93⅜	86⅛	87⅜	Fe. 1, Fe. 15 Q	0.75
Patino M. & E.	New York	26⅛	24⅜	25¼	De. 31, Ja. 14	4s.
ASBESTOS						
Asbestos Corp.	Montreal	31⅛	30	30⅜	Jan., 1926	1.50
Asbestos Corp. pfd.	Montreal	94	91	93⅛	Ma. 31, Ap. 16 Q	1.75
SULPHUR						
Freeport Texas	New York	84⅛	80⅜	84⅛	Ap.14, Ma.1 QX	1.75
Texas Gulf	New York	78⅞	74⅜	78⅛	Ma. 1, Ma. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	41	40	41	Fe. 18, Ma. 1 Q	0.75
Amer. Metal, pfd.	New York	122	120	122	Fe. 18, Ma. 1 Q	1.75
Amer. Sm. & Ref.	New York	186⅜	174⅜	182½	De. 31, Fe. 1 Q	2.00
Amer. Sm. & Ref. pfd.	New York	139	131	136⅛	De. 31, Ma. 1 Q	1.75
Consol. M. & S.	Montreal	275	268	274½	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	164	157½	160⅝	Ma.31, Ap.16 Q	1.00
U. S. Sm. R. & M.	New York	42	39⅜	41½	Ja. 6, Ja. 14 Q	0.87½
U.S. Sm. R.&M. pfd.	New York	53⅜	53	53½	Ja. 6, Ja. 14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED MARCH 13, 1928

Name	High	Low	Last	Date	Amount	Last Div.
Aramayo Mines (25 frs.)	74/—	61/3	61/3	Feb., 1928	5	p.c. (†)
British Platinum (£1)	—/3	—/1½	—/1½	Feb., 1925	2½	p.c.
Burma Corpn. (10 rupees)	13/—	12/6	12/10½	Jan., 1928	6	annas*
Bwana M'Kubwa (5s)	4/6	4/3	4/4½	...	...	...
Camp Bird (2s)	4/1½	3/6	4/—	...	...	...
El Oro (£1)	5/—	4/6	4/6	Nov., 1924	2½	p.c.*
Esperanza (10s)	—/1½	—/1½	—/1½	...	...	...
Frontino & Bolivia (£1)	14/9	14/3	14/3	Jan., 1928	5	p.c.
Mexican Corpn. (£1)	10/9	9/9	10/—	...	...	...
Mexico Mines of El Oro (£1)	35/—	30/7½	35/—	Dec., 1926	3¾	p.c.*
N'Changa Copper Mining	10/—	10/—	10/—	...	...	...
Oroville Dredging (£1)	4/—	3/4½	4/—	Dec., 1923	3¾	p.c.
Ouro Preto (£1)	—/7½	—/7½	—/7½	May, 1925	2½	p.c.
Rhodesian Congo Border (£1)	22/3	20/—	21/3	...	...	...
St. John del Rey (£1)	13/3	10/6	12/6	April, 1928	7½	p.c.
San Francisco Mines (10s)	28 3	27/4½	27/9	Jan., 1928	25s.	...
Santa Gertrudis (£1)	16/3	15/—	15/9	Jan., 1928	7½	p.c.
Selukwe (2s. 6d.)	7/9	7/6	7/9	April, 1917	6¼	p.c.
S. Amer. Copper (2s.)	1/7½	1/4½	1/6	Nov., 1917	75	p.c.
Tanganyika (£1)	66/10½	62/6	65/7½	Aug., 1927	7½	p.c.
Union Miniere de Haut-Katanga (Brussels)	793.75	778.0	778.0	July, 1927	182.60	(‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.